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Dallala et al.

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(54) **AUTHORING AND RUNNING TASK-BASED FLOWS WITHIN A COMPUTING SYSTEM**

(71) Applicant: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

(72) Inventors: **Daniel Dallala**, Seattle, WA (US); **Hao Zhou**, Issaquah, WA (US); **Tobin James Zerba**, Seattle, WA (US); **Mesganaw G. Anteneh**, Redmond, WA (US); **Indrojit N. Deb**, Sammamish, WA (US); **Nirav Shah**, Bothell, WA (US); **Elizabeth Rose Steinke**, Seattle, WA (US); **Shashi Ranjan**, Redmond, WA (US); **Bharath Swaminathan**, Renton, WA (US); **Richard L. Dickinson**, Seattle, WA (US); **Monisha Rochlani**, Redmond, WA (US); **Tong Gao**, Redmond, WA (US); **Jianjun Wang**, Bellevue, WA (US); **Zhi Jun Zhao**, Sammamish, WA (US)

(73) Assignee: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

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(21) Appl. No.: **15/162,984**

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(51) **Int. Cl.**

G06F 9/451	(2018.01)
G06F 9/455	(2018.01)
G06F 9/48	(2006.01)

(52) **U.S. Cl.**
CPC ***G06F 9/4843*** (2013.01); ***G06F 9/451*** (2018.02); ***G06F 9/45512*** (2013.01)

(58) **Field of Classification Search**
CPC ... G06F 9/4843; G06F 9/4443; G06F 9/45512
See application file for complete search history.

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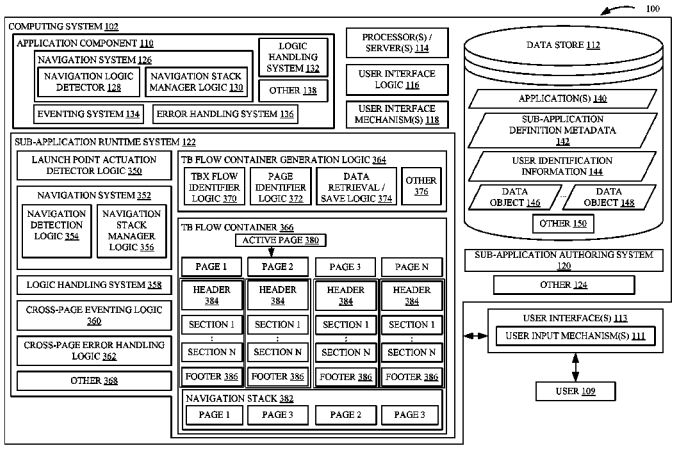
Primary Examiner — Emerson C Puente
Assistant Examiner — Jonathan R Labud
(74) *Attorney, Agent, or Firm* — Christopher J. Volkmann; Kelly, Holt & Christenson, PLLC

(57) **ABSTRACT**

A task-based sub-application surfaces only controls that are needed to perform a task, from a plurality of different forms in a parent application. A sub-application system runs the sub-application by executing navigation logic and maintaining a separate navigation stack, so that the user can perform a task without the computer system needing to surface entire forms where only a small subset of the controls on those forms are needed to perform the task.

20 Claims, 15 Drawing Sheets



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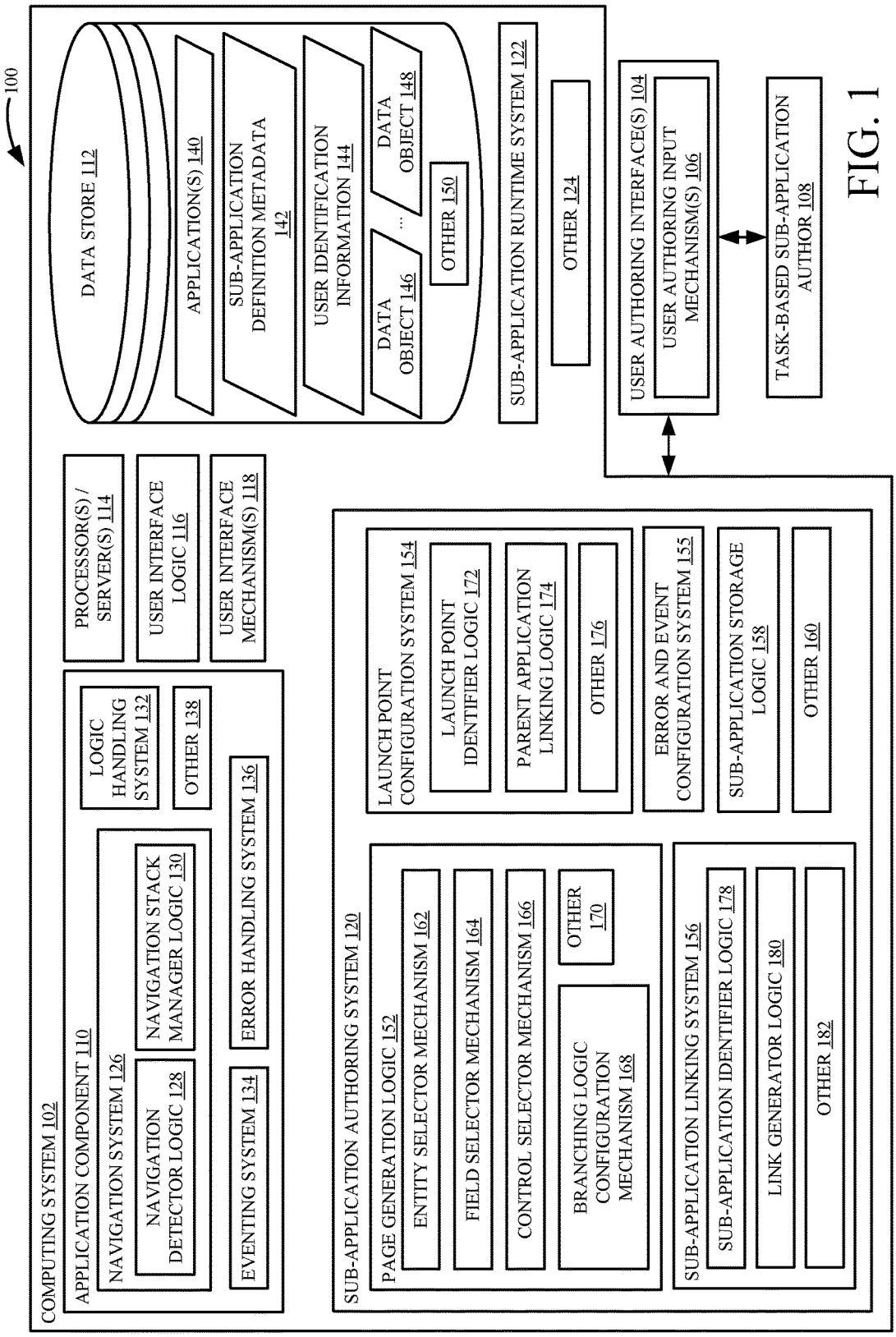
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COMPUTING SYSTEM 102
DATA STORE 112
APPLICATION(S) 140
SUB-APPLICATION DEFINITION METADATA 142
USER IDENTIFICATION INFORMATION 144
DATA OBJECT 146
...
DATA OBJECT 148
OTHER 150
SUB-APPLICATION RUNTIME SYSTEM 122
OTHER 124
USER AUTHORING INTERFACE(S) 104
USER AUTHORING INPUT MECHANISM(S) 106
TASK-BASED SUB-APPLICATION AUTHOR 108
PROCESSOR(S) / SERVER(S) 114
USER INTERFACE LOGIC 116
USER INTERFACE MECHANISM(S) 118
APPLICATION COMPONENT 110
NAVIGATION SYSTEM 126
NAVIGATION DETECTOR LOGIC 128
NAVIGATION STACK MANAGER LOGIC 130
LOGIC HANDLING SYSTEM 132
OTHER 138
EVENTING SYSTEM 134
ERROR HANDLING SYSTEM 136
SUB-APPLICATION AUTHORING SYSTEM 120
PAGE GENERATION LOGIC 152
ENTITY SELECTOR MECHANISM 162
FIELD SELECTOR MECHANISM 164
CONTROL SELECTOR MECHANISM 166
BRANCHING LOGIC CONFIGURATION MECHANISM 168
OTHER 170
LAUNCH POINT CONFIGURATION SYSTEM 154
LAUNCH POINT IDENTIFIER LOGIC 172
PARENT APPLICATION LINKING LOGIC 174
OTHER 176
ERROR AND EVENT CONFIGURATION SYSTEM 155
SUB-APPLICATION STORAGE LOGIC 158
OTHER 160
SUB-APPLICATION LINKING SYSTEM 156
SUB-APPLICATION IDENTIFIER LOGIC 178
LINK GENERATOR LOGIC 180
OTHER 182

FIG. 1

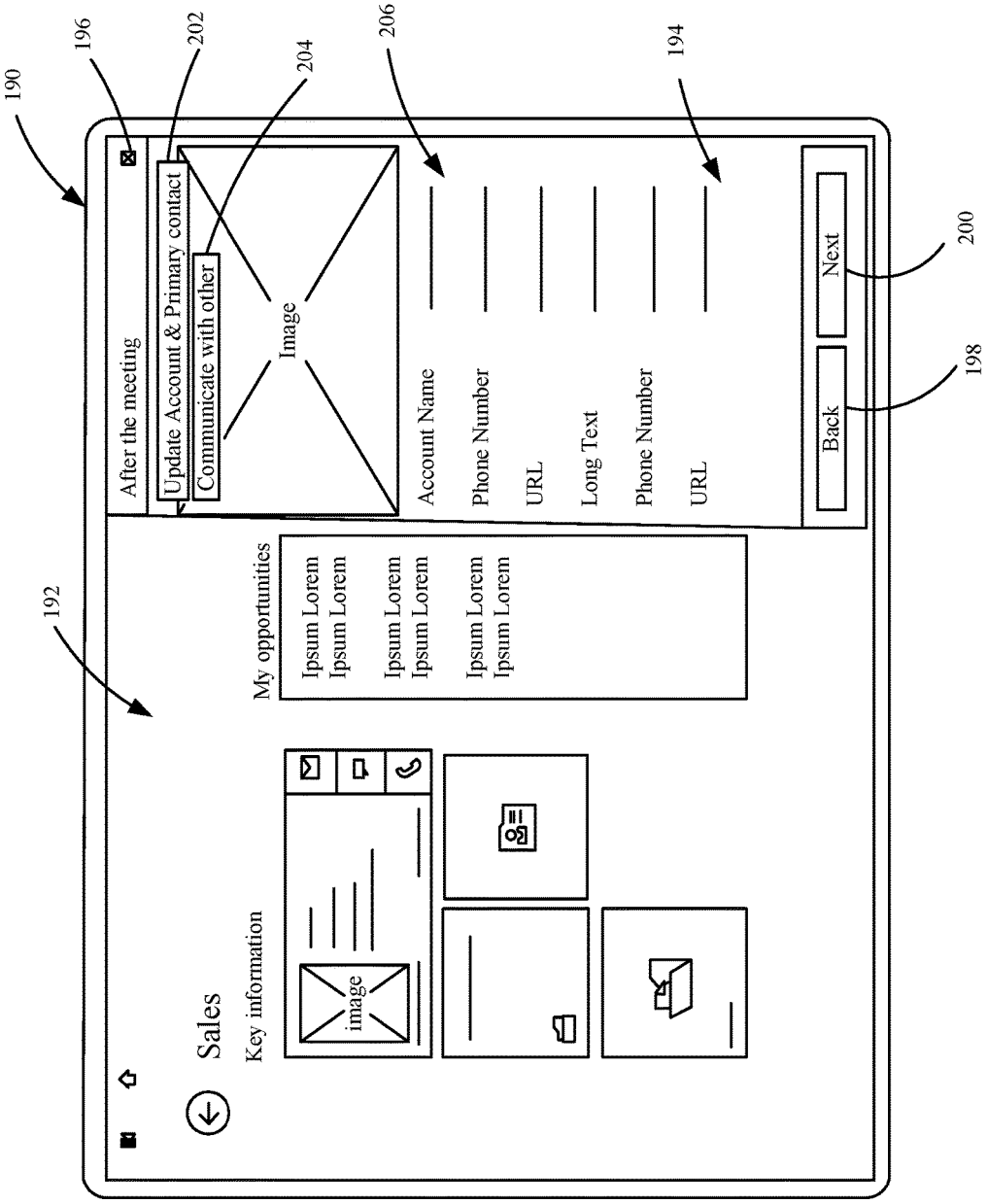

190
196
202
204
206
194
200
198
192
After the meeting
Update Account & Primary contact
Communicate with other
Image
Account Name
Phone Number
URL
Long Text
Phone Number
URL
Back
Next
My opportunities
Ipsum Lorem
Ipsum Lorem
Ipsum Lorem
Ipsum Lorem
Ipsum Lorem
Ipsum Lorem
Sales
Key information
image

FIG. 1A

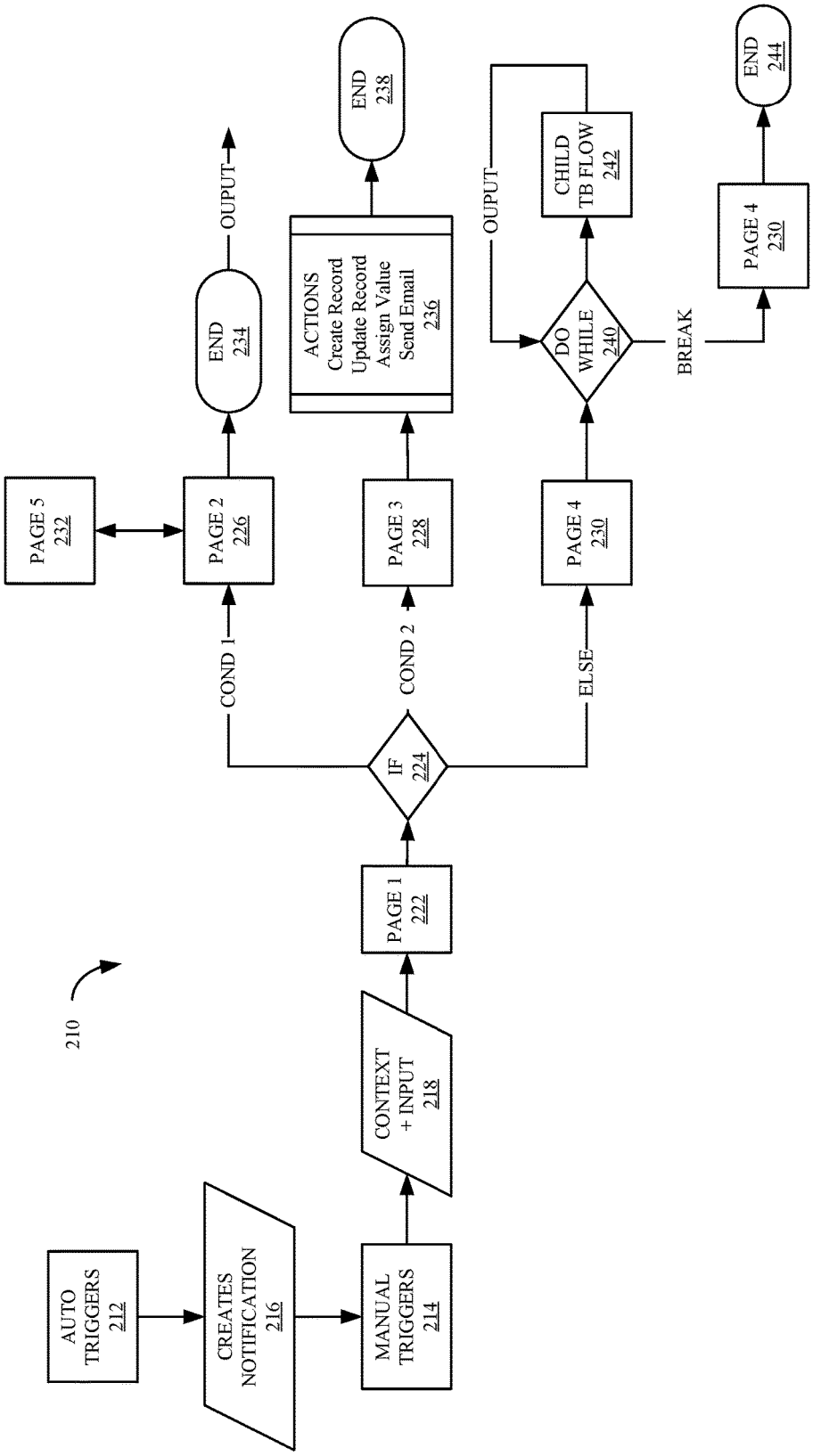

210
AUTO TRIGGERS 212
CREATES NOTIFICATION 216
MANUAL TRIGGERS 214
CONTEXT + INPUT 218
PAGE 1 222
IF 224
COND 1
COND 2
ELSE
PAGE 5 232
PAGE 2 226
END 234
OUPUT
PAGE 3 228
ACTIONS
Create Record
Update Record
Assign Value
Send Email
236
END 238
PAGE 4 230
DO WHILE 240
OUPUT
CHILD TB FLOW 242
BREAK
PAGE 4 230
END 244

FIG. 1B

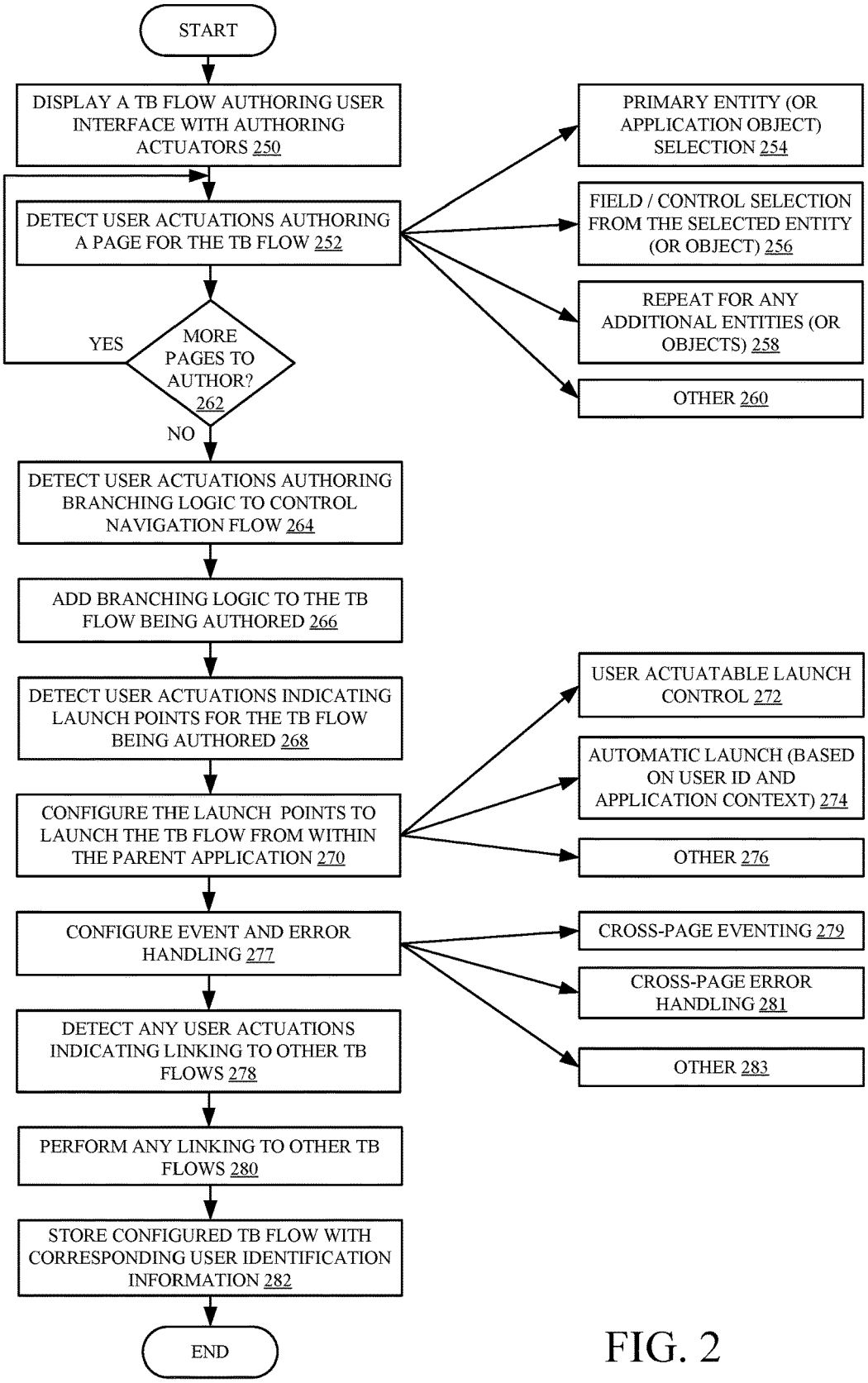

START
DISPLAY A TB FLOW AUTHORING USER INTERFACE WITH AUTHORING ACTUATORS 250
DETECT USER ACTUATIONS AUTHORING A PAGE FOR THE TB FLOW 252
PRIMARY ENTITY (OR APPLICATION OBJECT) SELECTION 254
FIELD / CONTROL SELECTION FROM THE SELECTED ENTITY (OR OBJECT) 256
REPEAT FOR ANY ADDITIONAL ENTITIES (OR OBJECTS) 258
OTHER 260
YES
MORE PAGES TO AUTHOR? 262
NO
DETECT USER ACTUATIONS AUTHORING BRANCHING LOGIC TO CONTROL NAVIGATION FLOW 264
ADD BRANCHING LOGIC TO THE TB FLOW BEING AUTHORED 266
DETECT USER ACTUATIONS INDICATING LAUNCH POINTS FOR THE TB FLOW BEING AUTHORED 268
CONFIGURE THE LAUNCH POINTS TO LAUNCH THE TB FLOW FROM WITHIN THE PARENT APPLICATION 270
USER ACTUATABLE LAUNCH CONTROL 272
AUTOMATIC LAUNCH (BASED ON USER ID AND APPLICATION CONTEXT) 274
OTHER 276
CONFIGURE EVENT AND ERROR HANDLING 277
CROSS-PAGE EVENTING 279
CROSS-PAGE ERROR HANDLING 281
OTHER 283
DETECT ANY USER ACTUATIONS INDICATING LINKING TO OTHER TB FLOWS 278
PERFORM ANY LINKING TO OTHER TB FLOWS 280
STORE CONFIGURED TB FLOW WITH CORRESPONDING USER IDENTIFICATION INFORMATION 282
END

FIG. 2

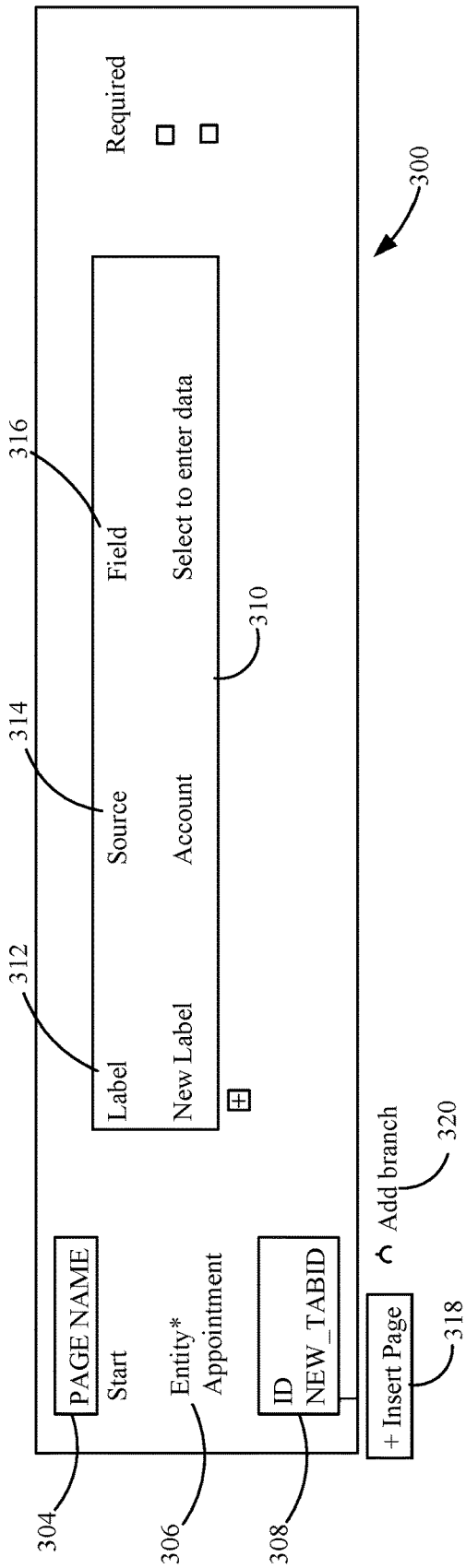

300
PAGE NAME
Start
Entity*
Appointment
ID
NEW_TABID
+ Insert Page
Add branch
Label
New Label
Source
Account
Field
Select to enter data
Required
304
306
308
310
312
314
316
318
320

FIG. 2A

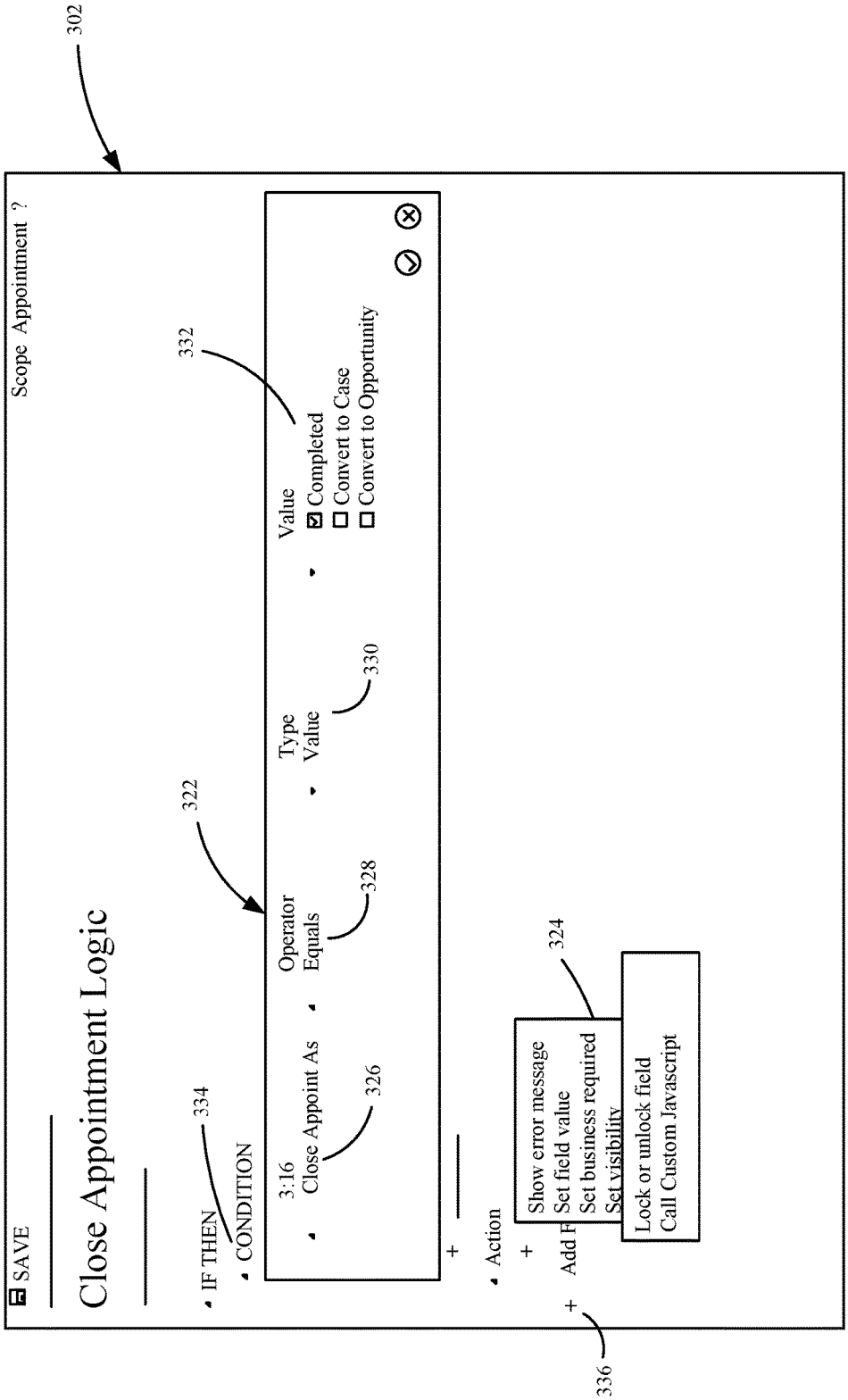
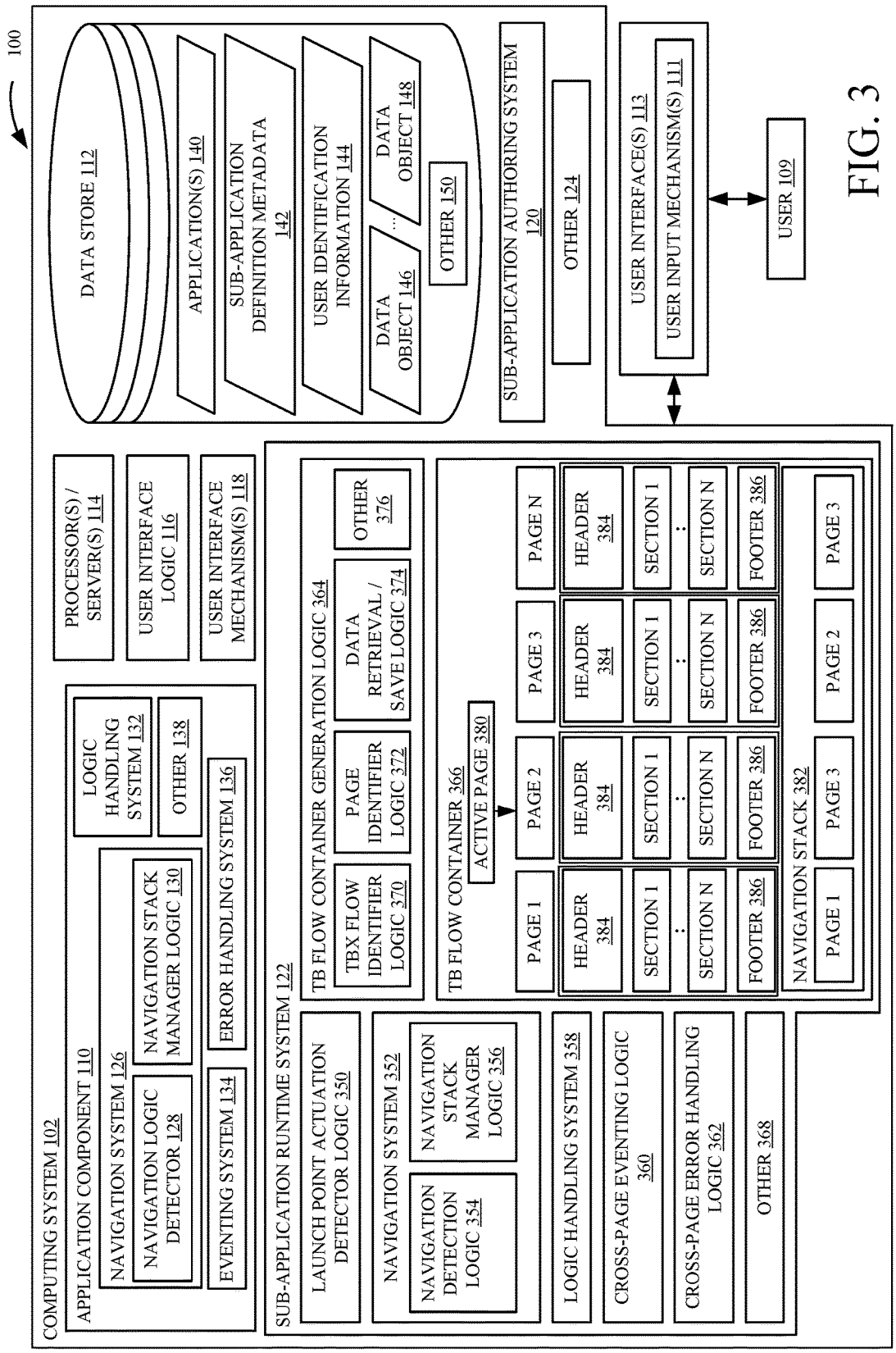

302
SAVE
Scope Appointment ?
Close Appointment Logic
IF THEN
CONDITION
334
322
3:16
Close Appoint As
326
Operator
Equals
328
Type
Value
330
332
Value
Completed
Convert to Case
Convert to Opportunity
Action
Show error message
Set field value
Set business required
Set visibility
324
Lock or unlock field
Call Custom Javascript
336

FIG. 2B


100
DATA STORE 112
APPLICATION(S) 140
SUB-APPLICATION DEFINITION METADATA 142
USER IDENTIFICATION INFORMATION 144
DATA OBJECT 146
DATA OBJECT 148
OTHER 150
SUB-APPLICATION AUTHORING SYSTEM 120
OTHER 124
USER INTERFACE(S) 113
USER INPUT MECHANISM(S) 111
USER 109
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SUB-APPLICATION RUNTIME SYSTEM 122
TB FLOW CONTAINER GENERATION LOGIC 364
TBX FLOW IDENTIFIER LOGIC 370
PAGE IDENTIFIER LOGIC 372
DATA RETRIEVAL / SAVE LOGIC 374
OTHER 376
TB FLOW CONTAINER 366
ACTIVE PAGE 380
PAGE 1
PAGE 2
PAGE 3
PAGE N
HEADER 384
SECTION 1
SECTION N
FOOTER 386
NAVIGATION STACK 382
PAGE 1
PAGE 2
PAGE 3
LAUNCH POINT ACTUATION DETECTOR LOGIC 350
NAVIGATION SYSTEM 352
NAVIGATION STACK MANAGER LOGIC 356
NAVIGATION DETECTION LOGIC 354
LOGIC HANDLING SYSTEM 358
CROSS-PAGE EVENTING LOGIC 360
CROSS-PAGE ERROR HANDLING LOGIC 362
OTHER 368

FIG. 3

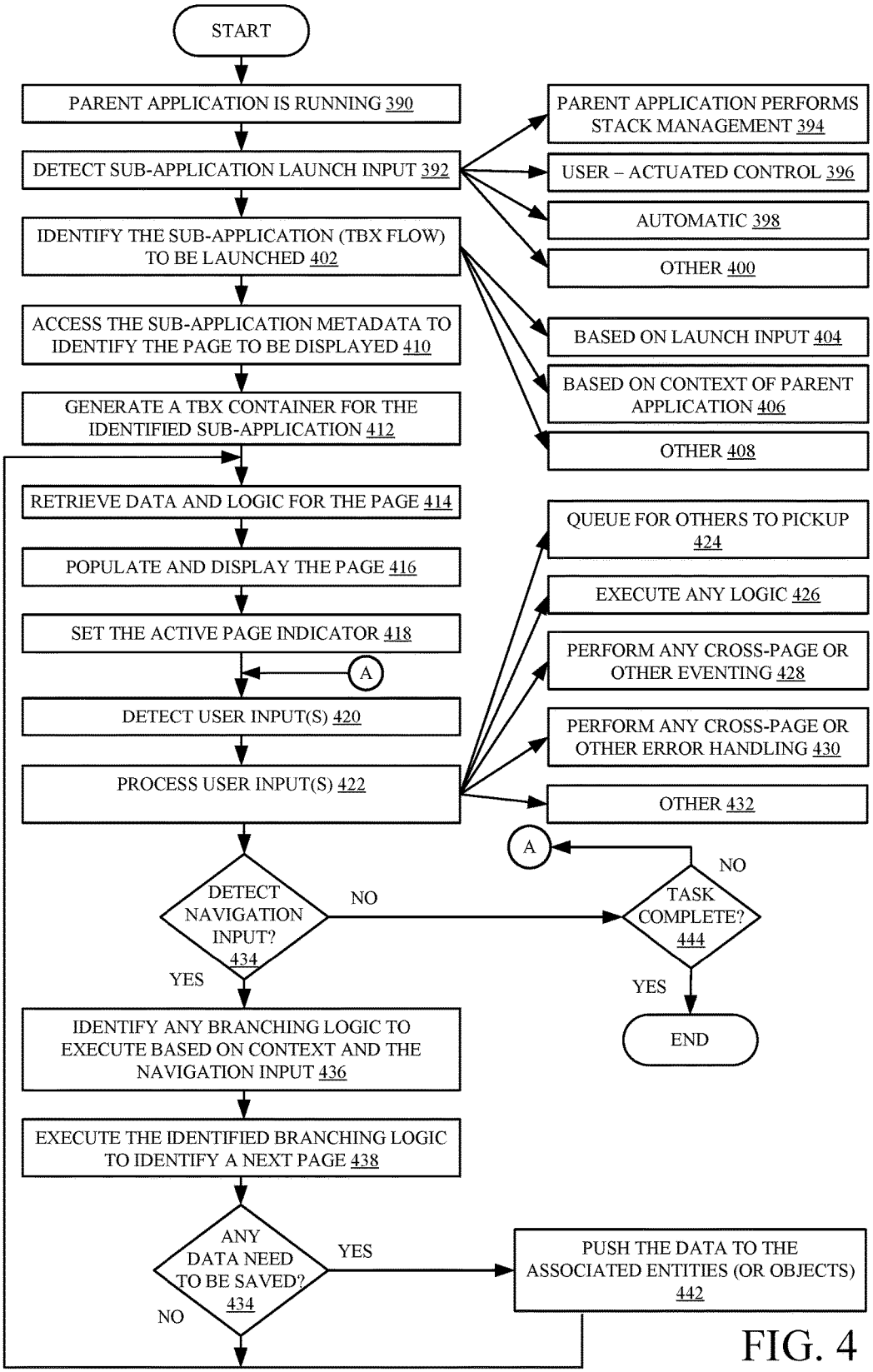
START
PARENT APPLICATION IS RUNNING 390
DETECT SUB-APPLICATION LAUNCH INPUT 392
PARENT APPLICATION PERFORMS STACK MANAGEMENT 394
USER – ACTUATED CONTROL 396
AUTOMATIC 398
OTHER 400
IDENTIFY THE SUB-APPLICATION (TBX FLOW) TO BE LAUNCHED 402
BASED ON LAUNCH INPUT 404
BASED ON CONTEXT OF PARENT APPLICATION 406
OTHER 408
ACCESS THE SUB-APPLICATION METADATA TO IDENTIFY THE PAGE TO BE DISPLAYED 410
GENERATE A TBX CONTAINER FOR THE IDENTIFIED SUB-APPLICATION 412
RETRIEVE DATA AND LOGIC FOR THE PAGE 414
POPULATE AND DISPLAY THE PAGE 416
SET THE ACTIVE PAGE INDICATOR 418
A
DETECT USER INPUT(S) 420
PROCESS USER INPUT(S) 422
QUEUE FOR OTHERS TO PICKUP 424
EXECUTE ANY LOGIC 426
PERFORM ANY CROSS-PAGE OR OTHER EVENTING 428
PERFORM ANY CROSS-PAGE OR OTHER ERROR HANDLING 430
OTHER 432
DETECT NAVIGATION INPUT? 434
NO
YES
A
NO
TASK COMPLETE? 444
YES
END
IDENTIFY ANY BRANCHING LOGIC TO EXECUTE BASED ON CONTEXT AND THE NAVIGATION INPUT 436
EXECUTE THE IDENTIFIED BRANCHING LOGIC TO IDENTIFY A NEXT PAGE 438
ANY DATA NEED TO BE SAVED? 434
YES
NO
PUSH THE DATA TO THE ASSOCIATED ENTITIES (OR OBJECTS) 442

FIG. 4

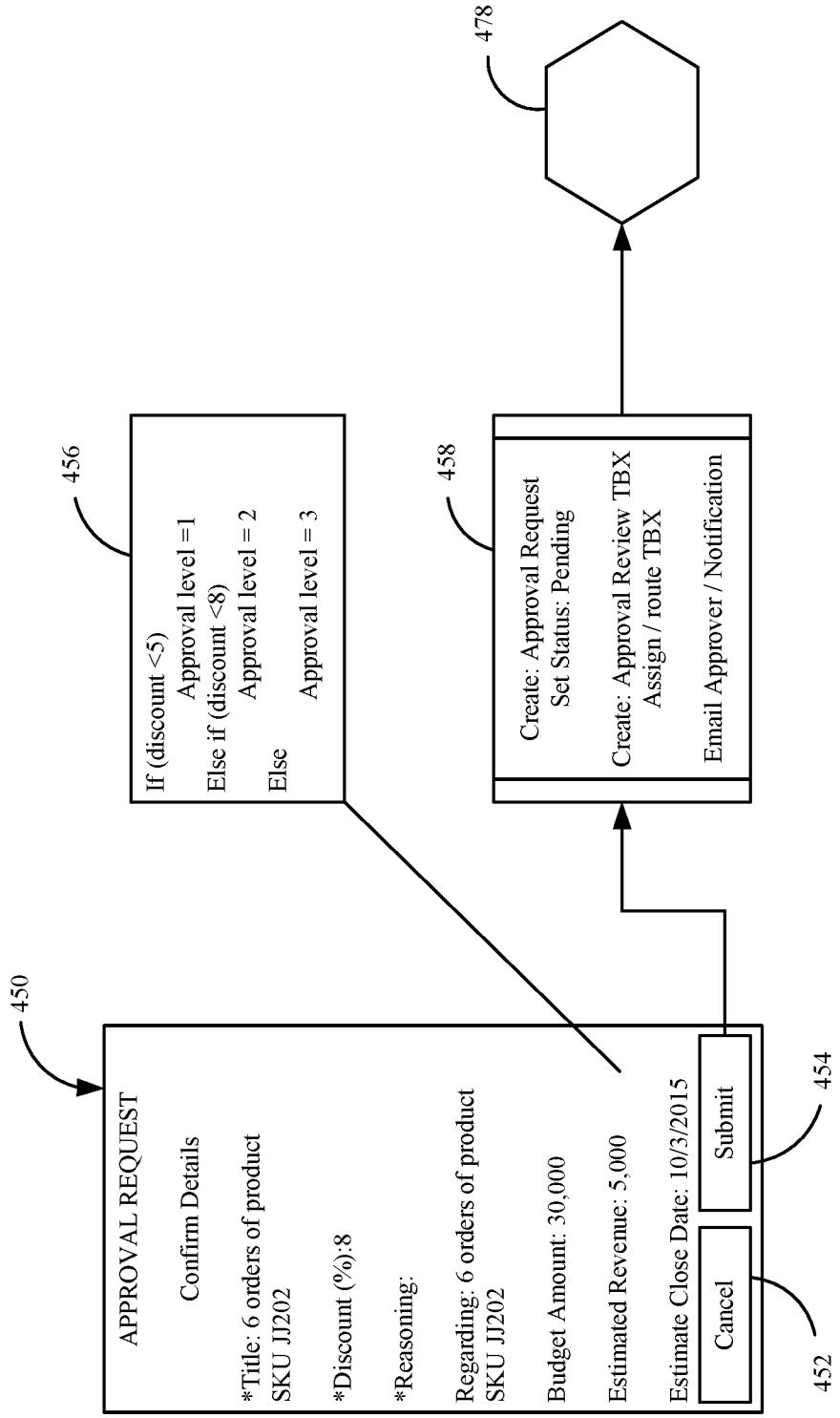
450
APPROVAL REQUEST
Confirm Details
*Title: 6 orders of product SKU JJ202
*Discount (%):8
*Reasoning:
Regarding: 6 orders of product SKU JJ202
Budget Amount: 30,000
Estimated Revenue: 5,000
Estimate Close Date: 10/3/2015
Cancel
Submit
452
454
456
If (discount <5)
Approval level =1
Else if (discount <8)
Approval level = 2
Else
Approval level = 3
458
Create: Approval Request
Set Status: Pending
Create: Approval Review TBX
Assign / route TBX
Email Approver / Notification
478

FIG. 5

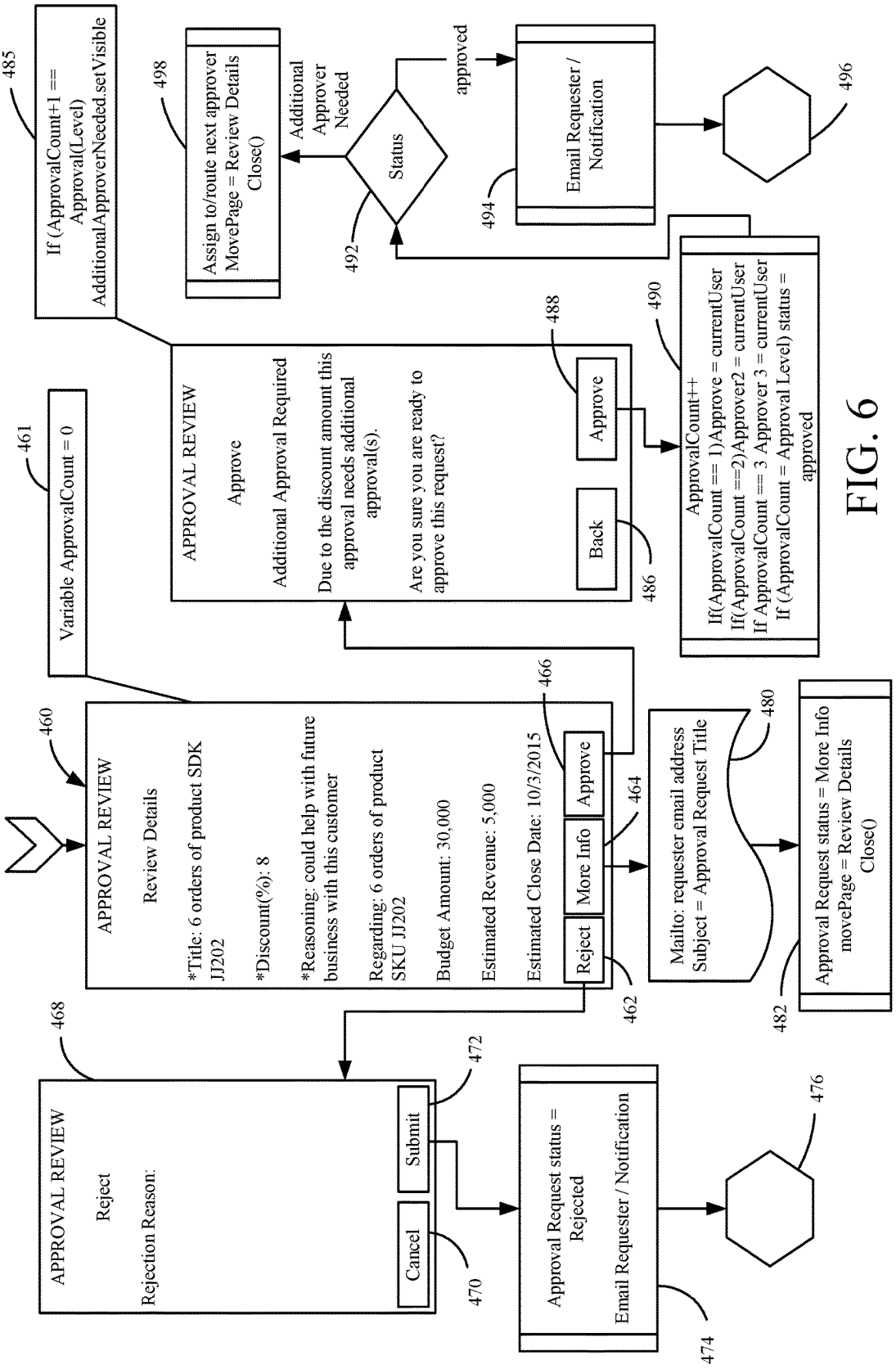
485
If (ApprovalCount+1 == Approval(Level) AdditionalApproverNeeded.setVisible
498
Assign to/route next approver MovePage = Review Details Close()
Additional Approver Needed
Status
492
approved
Email Requester / Notification
494
496
Variable ApprovalCount = 0
461
APPROVAL REVIEW
Approve
Additional Approval Required
Due to the discount amount this approval needs additional approval(s).
Are you sure you are ready to approve this request?
Approve
Back
488
486
490
ApprovalCount++
If(ApprovalCount == 1)Approve = currentUser
If(ApprovalCount ==2)Approver2 = currentUser
If ApprovalCount == 3 Approver 3 = currentUser
If (ApprovalCount = Approval Level) status = approved
460
APPROVAL REVIEW
Review Details
*Title: 6 orders of product SDK JJ202
*Discount(%): 8
*Reasoning: could help with future business with this customer
Regarding: 6 orders of product SKU JJ202
Budget Amount: 30,000
Estimated Revenue: 5,000
Estimated Close Date: 10/3/2015
Reject
More Info
Approve
466
464
462
Mailto: requester email address
Subject = Approval Request Title
480
482
Approval Request status = More Info
movePage = Review Details
Close()
468
APPROVAL REVIEW
Reject
Rejection Reason:
Cancel
Submit
472
470
Approval Request status = Rejected
Email Requester / Notification
474
476

FIG. 6

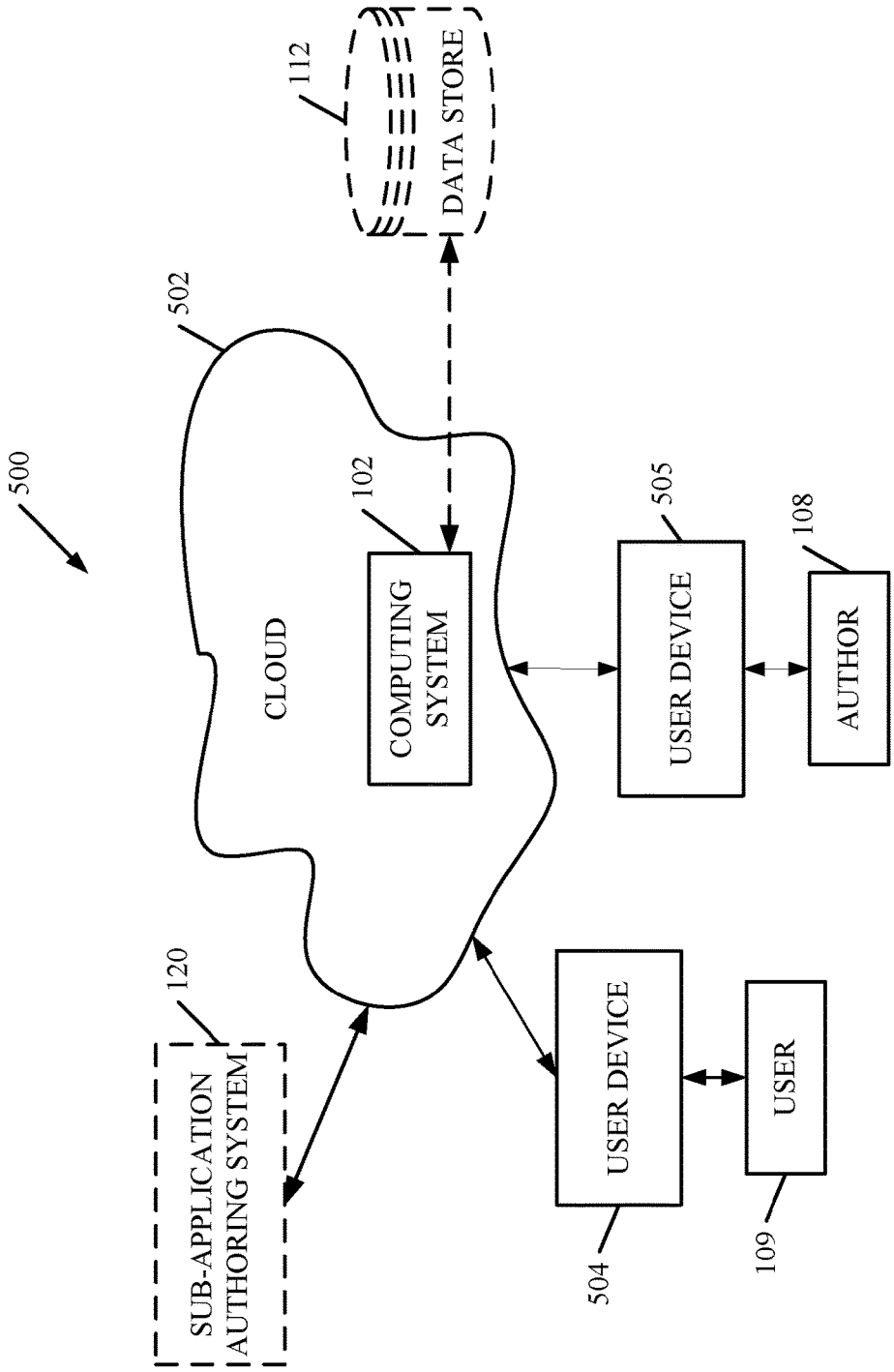
500
502
CLOUD
112
DATA STORE
102
COMPUTING SYSTEM
505
USER DEVICE
108
AUTHOR
120
SUB-APPLICATION AUTHORING SYSTEM
USER DEVICE
504
USER
109

FIG. 7

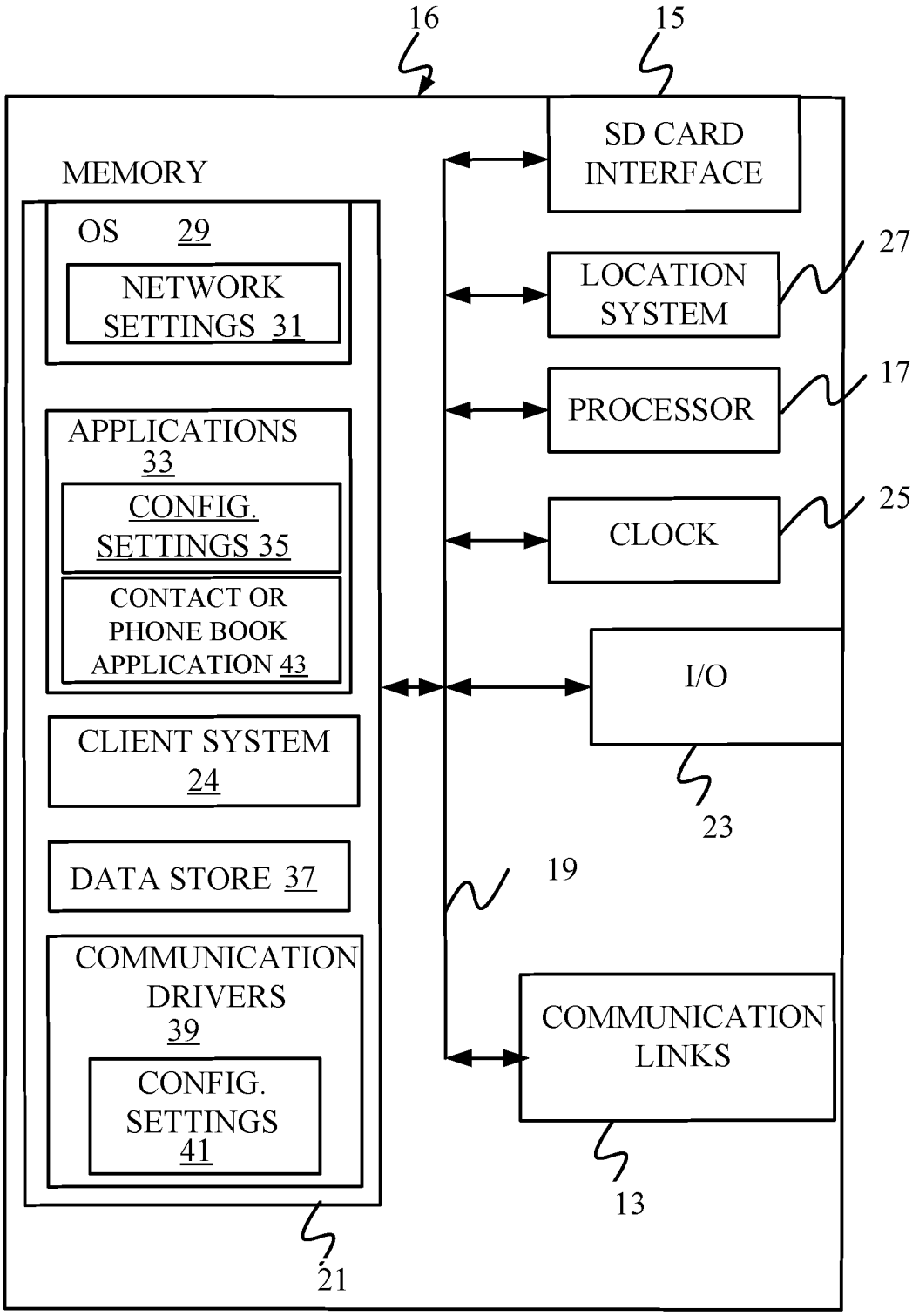
16
15
SD CARD INTERFACE
MEMORY
OS 29
NETWORK SETTINGS 31
27
LOCATION SYSTEM
17
PROCESSOR
APPLICATIONS 33
CONFIG. SETTINGS 35
25
CLOCK
CONTACT OR PHONE BOOK APPLICATION 43
I/O
CLIENT SYSTEM 24
23
19
DATA STORE 37
COMMUNICATION DRIVERS 39
CONFIG. SETTINGS 41
COMMUNICATION LINKS
13
21

FIG. 8

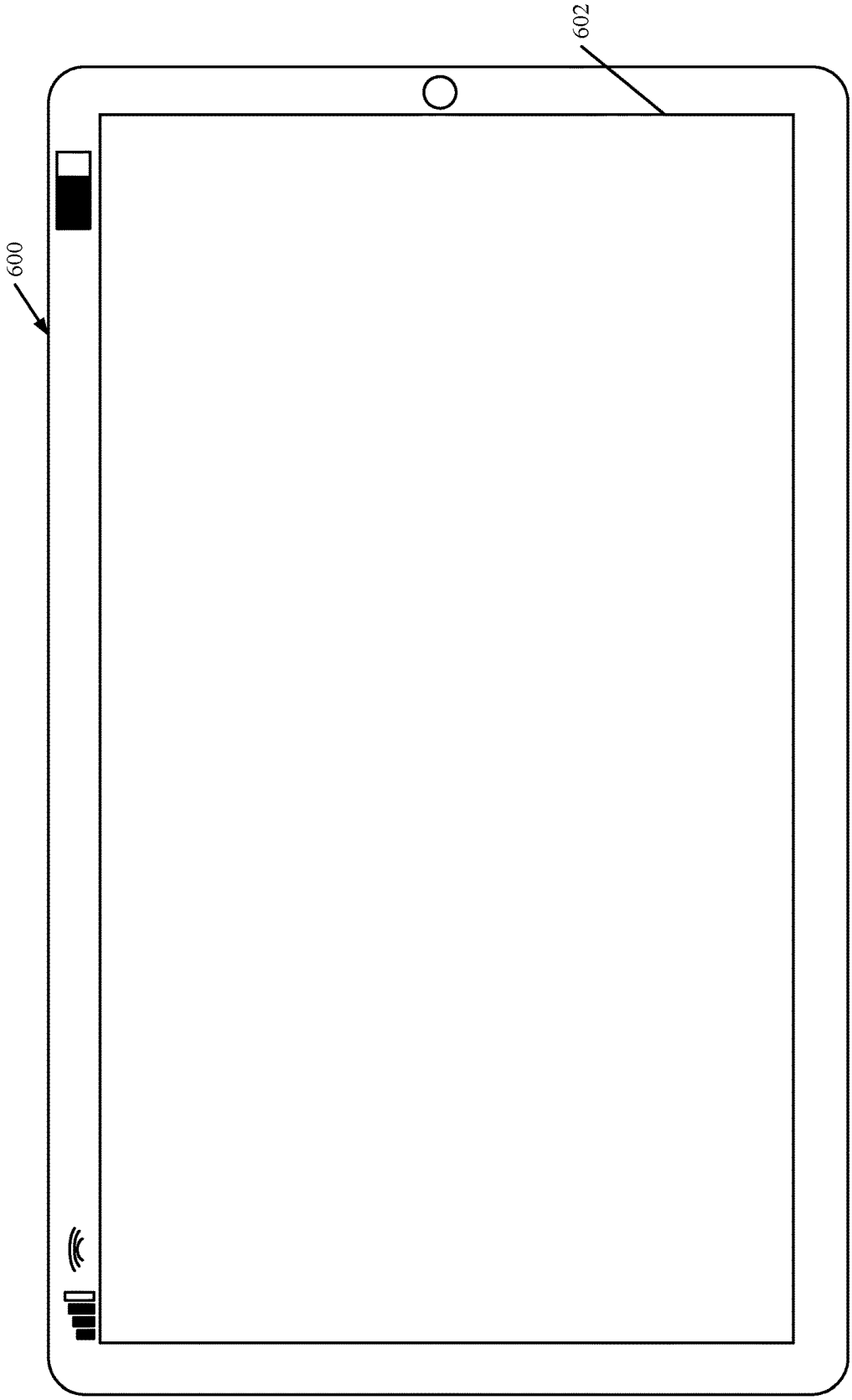

FIG. 9

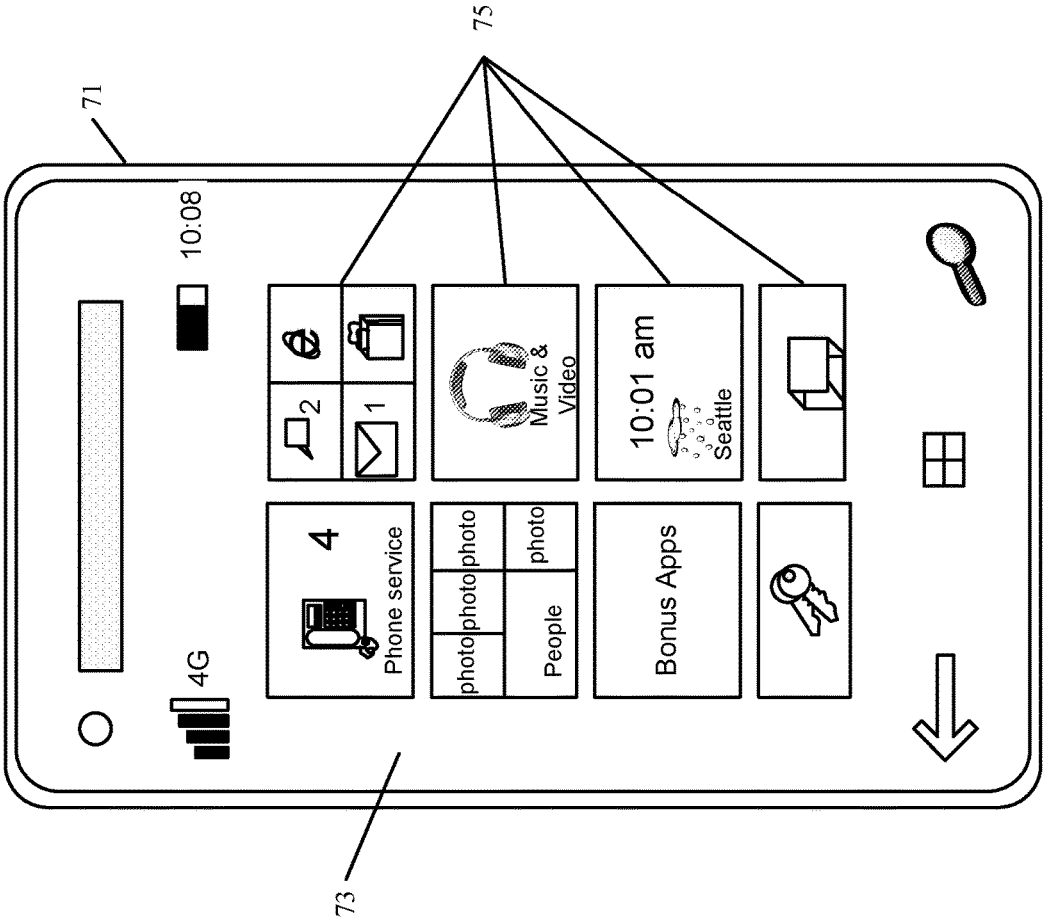
71
10:08
4G
4
Phone service
2
1
photo
photo
photo
photo
People
Music &
Video
Bonus Apps
10:01 am
Seattle
73
75

FIG. 10

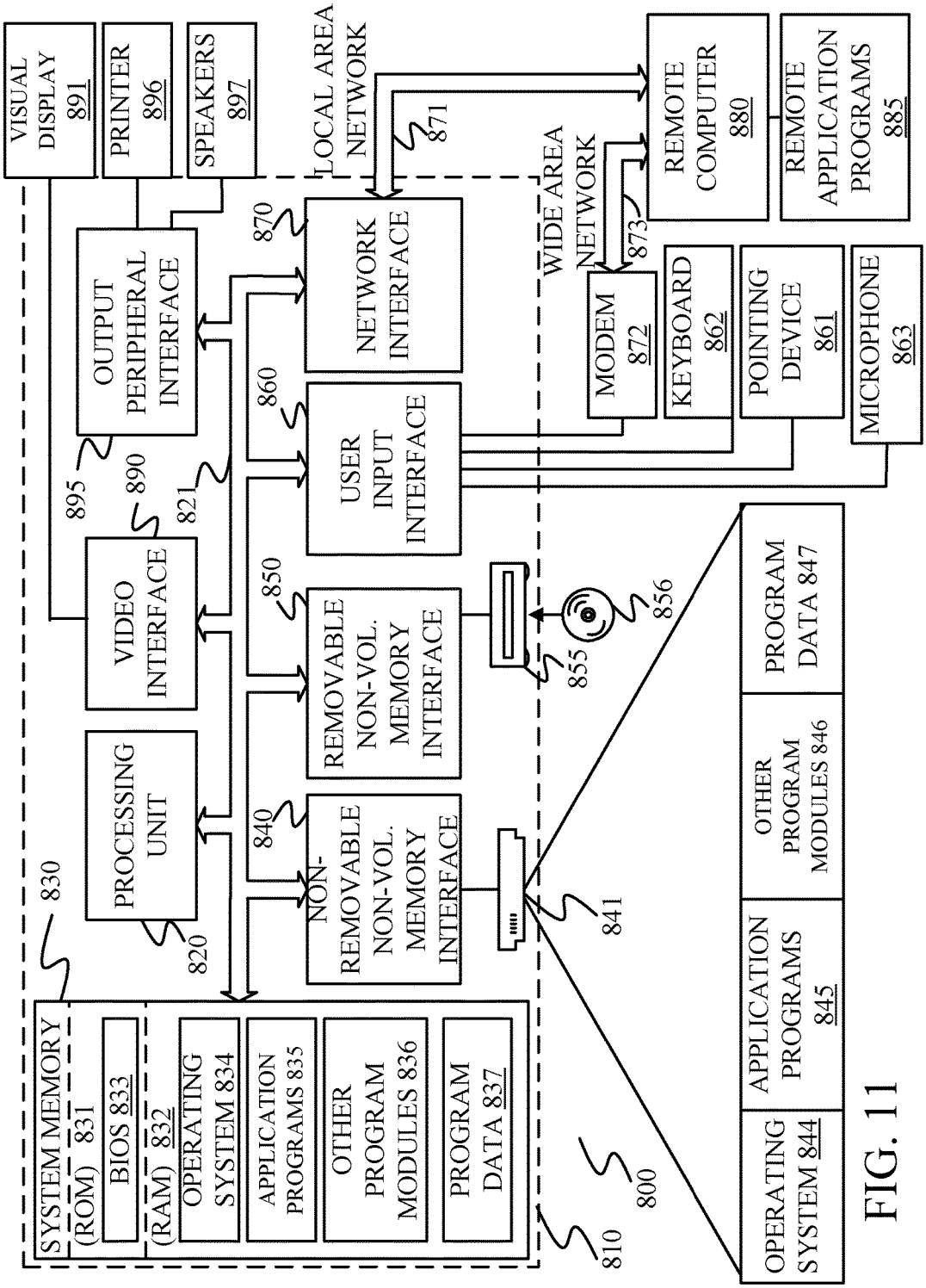
VISUAL DISPLAY 891
PRINTER 896
SPEAKERS 897
LOCAL AREA NETWORK
871
REMOTE COMPUTER 880
REMOTE APPLICATION PROGRAMS 885
870
NETWORK INTERFACE
WIDE AREA NETWORK
873
MODEM 872
KEYBOARD 862
POINTING DEVICE 861
MICROPHONE 863
OUTPUT PERIPHERAL INTERFACE
895
890
821
860
USER INPUT INTERFACE
VIDEO INTERFACE
850
REMOVABLE NON-VOL. MEMORY INTERFACE
855
856
PROGRAM DATA 847
PROCESSING UNIT
820
840
NON-REMOVABLE NON-VOL. MEMORY INTERFACE
841
OTHER PROGRAM MODULES 846
830
SYSTEM MEMORY
(ROM) 831
BIOS 833
(RAM) 832
OPERATING SYSTEM 834
APPLICATION PROGRAMS 835
OTHER PROGRAM MODULES 836
PROGRAM DATA 837
APPLICATION PROGRAMS 845
800
810
OPERATING SYSTEM 844

FIG. 11

AUTHORING AND RUNNING TASK-BASED FLOWS WITHIN A COMPUTING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

The present application is based on and claims the benefit of U.S. provisional patent application Ser. No. 62/240,883, filed Oct. 13, 2015, the content of which is hereby incorporated by reference in its entirety.

BACKGROUND

Computer systems are currently in wide use. Some computer systems run an application that has multiple different processes. The processes may be manually driven processes, or machine driven processes, that are executed by the computer.

In such computing systems, the processes are often related to, or operate on, data objects that are defined in the computing system and that are populated with data stored in tables in an underlying data store. The application objects (sometimes referred to as entities) may have callable methods that can be invoked in order to perform various functions using the object. In addition, each object (or at least some of the objects) may be represented by a page or form that is surfaced, and populated, in order to visualize and use the object. The processes often operate on, or at least are related to, the objects.

Therefore, in order to perform a process, a user often needs to control the computing system to surface a form corresponding to an object, and then perform operations relative to that object using that form, then to close the form and open another form, corresponding to another object and perform operations relative to that form, etc. This can continue, through multiple different forms.

There may be thousands of different forms in such computing systems. Each form may have hundreds of different controls or control states. Therefore, in order for a user to perform a process, this can consume a great deal of processing overhead in order to access the underlying data store so that each form can be populated and surfaced for the user, and then saved back to the underlying data store once the user has finished performing operations on that form and corresponding object. This type of process may also be relatively cumbersome for the user.

The discussion above is merely provided for general background information and is not intended to be used as an aid in determining the scope of the claimed subject matter.

SUMMARY

A task-based sub-application surfaces only controls that are needed to perform a task, from a plurality of different forms in a parent application. A sub-application system runs the sub-application by executing navigation logic and maintaining a separate navigation stack, so that the user can perform a task without the computer system needing to surface entire forms where only a small subset of the controls on those forms are needed to perform the task.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter. The claimed subject matter is not limited to implementations that solve any or all disadvantages noted in the background.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of one example of a computing system having a task-based sub-application authoring system.

FIG. **1**A shows one example of a task-based sub-application user interface display.

FIG. **1**B is a flow diagram illustrating one example of the flow of a task-based sub-application.

FIG. **2** is a flow diagram illustrating the overall operation of the computing system shown in FIG. **1** in allowing a user or developer to author a task-based sub-application.

FIGS. **2**A and **2**B are examples of user interface displays that can be generated during the authoring process.

FIG. **3** is a block diagram showing the computing system illustrated in FIG. **1** with the sub-application runtime system shown in more detail.

FIG. **4** is a flow diagram illustrating the operation of the computing system illustrated in FIG. **3**, during runtime operation of a task-based sub-application.

FIGS. **5** and **6** are flow diagrams, with corresponding user interface displays, showing the operation of one example of a task-based sub-application and a child task-based sub-application.

FIG. **7** is a block diagram of the computing system illustrated in FIGS. **1** and **3** above, deployed in a cloud computing architecture.

FIGS. **8-10** show examples of mobile devices.

FIG. **11** is a block diagram of one example of a computing environment that can be used in the architectures shown in previous figures.

DETAILED DESCRIPTION

FIG. **1** is a block diagram of one example of a computing system architecture **100** that includes computing system **102**. Computing system **102** illustratively generates user authoring interfaces **104** with user authoring input mechanisms **106** for interaction by a task-based sub-application author **108**. Author **108** illustratively interacts with user input mechanisms **106** in order to author a task-based sub-application (also referred to herein as a task-based flow).

Computing system **102** illustratively includes application component **110**, data store **112**, one or more processors or servers **114**, user interface logic **116**, user interface mechanisms **118**, sub-application authoring system **120**, sub-application runtime system **122**, and it can include other items **124**. Before describing the overall operation of computing system **102** in more detail, a brief discussion of some of the items in computing system **102**, and their functionality, will first be provided.

Application component **110** illustratively includes navigation system **126** (which, itself, can include navigation detector logic **128** and navigation stack manager logic **130**). Component **110** also illustratively includes logic handling system **132**, eventing system **134**, error handling system **136**, and it can include other items **138**.

Data store **112** illustratively includes one or more applications **140**, sub-application definition metadata **142** that defines task-based sub-applications that can run from within one or more of the applications **140**, user identification information **144**, and a set of data objects **146-148**. Data store **112** can include other items **150** as well.

Application component **110** illustratively loads and runs applications **140** that allow a user to perform processes within computing system **100**. Sub-application runtime system **122** illustratively launches and runs a task-based sub-application (or task-based flow) from within an application (e.g., a parent application) run by application component **110**.

In running a parent application **140**, navigation system **126** can navigate the user through various user interface displays or forms generated by the running application. Navigation detector logic **128** can detect navigation inputs (such as from a user, or automatic inputs) and navigation stack manager logic **130** manages a navigation stack, as the application is running. Logic handling system **132** illustratively handles (such as executes) logic contained on, or associated with, the forms that the user is navigating through, in running the application. Eventing system **134** performs eventing functionality (such as notifications, event handling, etc.) and error handling system **136** performs error handling functionality (such as generating error messages, etc.) for the running application. The application illustratively operates on data objects **146-148** in data store **112**, and it can perform a wide variety of other functionality and operate on other records as well.

In addition, while an application is running, the user interface logic **116** illustratively controls user interface mechanisms **118** in order to generate user interfaces for a user. The user interface mechanisms **118** can include a wide variety of different types of mechanisms, such as display screens, touch sensitive display screens, point and click devices, a keyboard, speech recognition components so that a user can provide speech inputs, speakers, a microphone, or a wide variety of other user interface mechanisms.

As briefly mentioned above, sub-application authoring system **120** can be used by author **108** in order to configure or author one or more task-based sub-applications (or task-based flows) so that a user of computing system **102** can perform a task by using the task-based flow. Sub-application runtime application **102** illustratively runs the sub-applications, when they are launched from a parent application **140**. FIG. **1** shows one example of sub-application authoring system **120** in more detail. FIG. **3** shows one example of sub-application runtime system **122** in more detail. Authoring a task-based flow is described first, and running one is described below.

Sub-application authoring system **120** illustratively includes page generation logic **152**, launch point configuration system **154**, error and event configuration system **155**, sub-application linking system **156**, sub-application storage logic **158**, and it can include a wide variety of other items **160**.

By way of overview, page generation logic **152** illustratively generates user interface displays, with user input mechanisms that can be actuated by author **108** in order to generate pages that can be displayed when the task-based flow is running. Launch point configuration system **154** illustratively generates user interface displays, with user input mechanisms, that allow author **108** to configure launch points within a parent application, where the user can launch the task-based flow, or where the task-based flow can be automatically lunched within the parent application. Sub-application linking system **156** illustratively generates user interface displays, with user input mechanisms, that allow author **108** to link a task-based flow that has just been authored, with one or more other task-based flows. By way of example, it may be that author **108** has just generated a task-based flow that allows a user to execute a task in order to pay an invoice. However, it may be that certain invoices need to be approved by the user's manager. Therefore, in one example, author **108** can configure the invoice payment task-based flow with branching logic that can be executed so that when a particular payment meets the conditions that require the payment to be authorized by the user's manager, then the logic automatically queues an approval request in an approval task-based flow for the user's manager. Examples of this will be described in greater detail below.

Sub-application storage logic **158** illustratively stores sub-application definition metadata **142**, that defines the task-based flow that has just been authored, in data store **112**. In doing so, it may link or otherwise associate the task-based flow with a given user or set of users or roles that will be allowed to run the task-based flow. For instance, logic **158** can store the sub-application definition metadata **142** and associate it with user identification information **144** that identifies the particular users or roles that will be allowed to run the task-based flow.

Again, by way of overview and prior to discussing how a task-based flow is authored and run, FIG. **1**A shows one example of a mobile device **190** that can run a parent application **140** and a task-based flow (or sub-application) **142**. It can be seen in FIG. **1**A that mobile device **190** has generated a first user interface display **192** that may be generated by a parent application **140**. From that user interface display, a user has launched a task-based flow (or it was automatically launched). The task-based flow then, when launched, generates user interface display **194**.

In the example shown in FIG. **1**A, the task-based flow that generates user interface display **194** is entitled "After the Meeting". It allows a user to perform a task, such as capture certain information about another party or organization, that was gained through a meeting. In the example shown in FIG. **1**A, the user can capture an account name, one or more phone numbers or URLs, and the user can also enter a description of the meeting. In prior systems, the user may have been required to open multiple different forms within the parent application, in order to update objects or entities within the parent application, with the information. With the task-based flow, however, the user can simply enter that information on a single page of the task-based flow, and then navigate to additional pages in order to perform additional steps within the task, for capturing information after a meeting with another party or organization.

Display **194** may be generated as a pop-up or otherwise generated from within the parent application. User interface display **194** can have a variety of different controls. For instance, it can have a close control **196** that can be actuated to close the task-based flow. It can have a set of navigation controls **198** and **200** that can be used to navigate through various pages configured within the task-based flow. It can have other controls **202** and **204** that can be actuated to launch separate task-based flows. In addition, it can have a variety of fields **206** that can be edited by the user or actuated by the user, or otherwise interacted with, by the user.

FIG. **1**B is a flow diagram corresponding to one example of a task-based flow **210**. FIG. **1**B is described as an example of one overall structure of a task-based flow, so that authoring a task-based flow (discussed below with respect to FIGS. **1** and **2**) may be better understood. Flow **210** can be launched or triggered automatically by automatic triggers **212**. Automatic triggers **212** may be event-based triggers or triggers generated from a client application programming interface (API) or otherwise. In addition, task-based flow **210** can be launched or triggered with a manual trigger **214**. Manual trigger **214** can be actuated from a command bar in

the parent application, from an interactive tile in the parent application, from a button or other user actuatable input mechanism in the parent application, etc. In addition in one example, the automatic trigger **212** generates a notification **216** which is placed in a notification queue in the parent application. The user can illustratively actuate or launch the task-based flow **210** from that notification. All of these, and other launch or trigger mechanisms are contemplated herein.

In the example shown in FIG. **1**B, once a trigger is actuated, the user interface logic sends a context of the present application, and the actuation input, to sub-application runtime system **120**, as indicated by block **218**. Runtime system **122** then generates a first page **222** of the task-based flow **210**, that has just been launched. Page **222** can take a wide variety of different forms. For instance, it may include bound controls, such as entity attributes, variables and process arguments, entity actions, etc. It can also include a set of free flow controls, such as buttons, lookup controls, label and progress bar controls, etc. In addition, the task-based flow **210** can have conditional or branching logic that is executed to navigate to different pages within task-based flow **210**. For instance, as indicated by block **224**, the logic in task-based flow **210** can evaluate a condition or set of conditions, based upon the inputs to, or control states on, page **222**. The task-based flow need not be linear. Instead, if a first condition is found to be present at block **224**, then a second page **226** can be displayed. If a second condition is found to be present, a third page **228** can be displayed, and otherwise, a fourth page **230** can be displayed. The user can then navigate to an additional page **232** from page **226**, or the user can end the task-based flow as indicated by block **234**.

From page **228**, the user (or the task-based flow, itself) can perform an action **236** (such as create a record, update a record, assign a value, send an electronic mail message, etc.), and the task-based flow can then be completed as indicated by block **238**.

From page **230**, another task-based flow (e.g., a child task-based flow) can be launched from within task-based flow **210**. This is indicated by blocks **240** and **242**. When the child task-based flow **242** returns, task-based flow **210** can return to page **230**, and then the task-based flow can be ended, as indicated by block **244**.

It will be noted that the flow diagram shown in FIG. **1**B is but one example of a configuration or structure for a task-based flow **210**, and a wide variety of other configurations or structures can be used as well. For instance, a task-based flow can be configured to be linear, it can be configured to only be launched by automatic triggers **212** or manual triggers **214**. It can be configured so that it does not launch a child task-based flow **242**, or it can be configured in a wide variety of other ways.

Returning again to the block diagram of FIG. **1**, the operation of sub-application authoring system **120** in authoring a task-based flow will now be described in more detail. Page generation logic **152** illustratively includes entity selector mechanism **162**, field selector mechanism **164**, control selector mechanism **166**, branching logic configuration mechanism **168**, and it can include other items **170**. Launch point configuration system **154** illustratively includes launch point identifier logic **172**, parent application linking logic **174**, and it can include other items **176**. Sub-application linking system **156** illustratively includes sub-application identifier logic **178**, link generator logic **180**, and it can include other items **182**. FIG. **2** is a flow diagram illustrating one example of the operation of authoring system **120**. FIGS. **2**A and **2**B show examples of portions of user interface displays that can be generated during the authoring process. FIGS. **1**, **2**, **2**A and **2**B will now be described in conjunction with one another.

It is first assumed that author **108** first provides an input through a user authoring interface **104** indicating to sub-application authoring system **120** that user **108** wishes to author or otherwise modify a task-based flow (or sub-application). In response, system **120** uses user interface logic **116** to display a task-based flow (or TBX) authoring user interface **104** with authoring input mechanisms or actuators **106**. Displaying the TBX authoring user interface **104** with authoring actuators **106** is indicated by block **250** in the flow diagram of FIG. **2**. In general, a user first authors one or more pages that are to be displayed in the task-based flow. The user then illustratively authors branching logic that controls navigation among those pages, and the user then configures launch points from which the task-based flow can be launched within the parent application. The user can then illustratively link the task-based flow to any other task-based flows that have been authored. The linked task-based flow can be launched as a child of the task-based flow being configured. The author **108** can also configure error and event handling within the task-based flow being authored.

Page generation logic **152** thus detects user actuations authoring a page for the task-based flow. This is indicated by block **252**. In order to do so, entity selector mechanism **162** illustratively displays an actuator that allows author **108** to select an entity (or application object) within the parent application. One of the entities or objects may be identified as a primary entity (or application object) that is selected for the task-based flow. This is indicated by block **254**. Field selector mechanism **164** and control selector mechanism **166** illustratively generate user interface displays with user input mechanisms that can be actuated by author **108** in order to select various fields or controls from the selected entity that will be included on the current task-based flow page being authored. Author **108** can also provide inputs that control where the fields or controls are displayed on the current task-based flow page. Selecting fields or controls from the selected entity is indicated by block **256** in FIG. **2**. Author **108** can repeat these steps (of selecting an entity or application object and selecting fields or controls from that application object that are to be displayed on the task-based flow page being generated) for any additional entities or application objects, as desired. This is indicated by block **258** in FIG. **2**. Author **108** can use page generation logic **152** to author the page for the task-based flow in other ways as well, and this is indicated by block **260**.

Once a current page for the task-based flow has been authored, the user can also repeat this process for additional pages that are to be displayed within the task-based flow. The user can provide additional page names and/or page identifiers for the additional pages, the user can select entities or application objects and fields or other controls on those entities or application objects, that are to be included on the page. Repeating these steps is indicated by block **262** in FIG. **2**. This can be done until all pages for the task-based flow are authored.

Branching logic configuration mechanism **168** also illustratively generates user interfaces with user input mechanisms that can be actuated by author **108** in order to configure branching logic that can be used to navigate through the various pages that have been generated for the task-based flow being authored. Mechanism **168** illustratively detects user actuations of those actuators and adds branching logic to the task-based flow, based upon those user inputs. Detecting the user authoring inputs indicative of

branching logic to be configured, and adding that branching logic to the task-based, flow is indicated by blocks **264** and **266** in FIG. **2**.

At this point in the flow diagram of FIG. **2**, author **108** has authored a set of pages that are to be displayed for the task-based flow, and has also authored or configured the branching logic that is used to navigate among those pages. Author **108** now illustratively uses launch point configuration system **154** to configure launch points, from which the task-based flow can be launched within the parent application. Thus, launch point identifier logic **172** illustratively generates a user interface with a user input mechanism that allows author **108** to identify points in the parent application from which the task-based flow can be launched. Detecting user actuations of those inputs and configuring the launch points to launch the task-based flow from within the parent application are indicated by blocks **268** and **270** in the flow diagram of FIG. **2**. In one example, the launch points can be user actuatable launch controls which, when actuated by the user, launch the task-based flow from within the parent application. This is indicated by block **272**. In another example, the launch points can automatically launch the task-based flow based upon a context of the parent application, and based upon user identification information indicative of the user that is interacting with the parent application. This is indicated by block **274**. It will be noted that the automatic launching of the task-based flow can be done in a completely automated way, without any user input, or it can be configured so that it generates a notification to the user and the user can launch the task-based flow, or at least authorize the task-based flow to be launched, based upon the automatically generated notification. The launch points can be configured in other ways as well, and this is indicated by block **276**. Parent application linking logic **174** then links the task-based flow to the parent application, through the launch points that have just been configured.

As discussed above, some task-based flows can be linked to other task-based flows so that the other task-based flows are launched as child flows from within the original task-based flow. Sub-application identifier logic **178** illustratively generates user interfaces, with user input mechanisms that can be actuated by author **108** to identify a child task-based flow that is to be launched (or otherwise linked to) from within the task-based flow that is currently being authored. Detecting actuation of those user inputs to identify the child task-based flow to be linked to the present task-based flow is indicated by block **278** in FIG. **2**. Based upon those user inputs, link generator logic **188** illustratively links the child flow to the current task-based flow being authored. This is indicated by block **280**.

Error and event configuration system **155** then exposes user interfaces with user input mechanisms that can be actuated by author **108** in order to configure event and error handling within the task-based flow. This is indicated by block **277** in FIG. **2**. In one example, system **155** generates user input mechanisms that can be actuated in order to configure cross-page eventing and cross-page error handling in the task-based flow. This is indicated by blocks **279** and **281** in FIG. **2**. For instance, the task-based flow can be configured so that when an event occurs on one page in the task-based flow, controls on other pages in the task-based flow will be notified of that event, if they have subscribed to receive such a notification. Similarly, it may be that an error on one page also causes an error on other pages in the task-based flow. In one example, both the events and errors can be handled in a cross-page manner, depending on how they are configured with system **155**, when the task-based flow is authored. The event and error handling can be configured in other ways as well, and this is indicated by block **283**. Sub-application storage logic **158** then stores the configured task-based flow (or the metadata representative of that flow) with corresponding user identification information that identifies a user or role that can launch the task-based flow. This is indicated by block **282**.

It will also be noted that the order of authoring can be different from that described above. For instance, the launch points may be configured first, or the branching logic may be configured after the launch points. These are examples only.

FIGS. **2**A and **2**B show examples of two different portions of user interface displays that can be generated by sub-application authoring system **120**, so that author **108** can author a task-based flow. FIG. **2**A shows a portion of a user interface display **300** that can be used to configure a page in a task-based flow, and FIG. **2**B shows a portion of a user interface display **302** that can be used to configure branching logic that is executed in the task-based flow. In FIG. **2**A, a page name control **304** allows the user to name the page. Control **304** can be a text box or other user input mechanism. Entity selector **306** allows the user to select a primary or secondary (or other) entity from which fields or other controls are to be used in generating the current page. Identification control **308** allows the user to select or input an identifier for the page, and attribute/label portion **310** includes controls that allow the user to input or select labels or attributes for the page. For instance, a label control **312** allows the user to input or select a label. A source control **314** allows the user to input or select a source of data, and a field control **316** allows the user to enter data into a field.

User interface display **300** also includes an insert page control **318** and an add branch control **320**. The user can include additional pages in the task-based flow by actuating control **318**. This takes the user to another page generation user experience where the user can generate another page. If the user actuates the add branch control **320**, the user is navigated to a logic configuration experience where the user can configure branching logic in the task-based flow.

User interface display **302** in FIG. **2**B shows that branching logic configuration mechanism **168** (in FIG. **1**) exposes various controls that can be actuated by author **108** to configure branching logic. In the example shown in FIG. **2**B, the branching logic to be configured is in the form of an "if-then" statement. Control **322** allows author **108** to specify a condition for the statement, and control **324** allows the author **108** to select or otherwise identify an action to be taken if the condition is met. In the condition configuration control **322**, the user can specify a field **326**, an operator **328**, a type **330** of the condition, and a particular value **332** for that type of condition. In the example, it can be seen that the condition has been set to be met if the field "Close Appointment" is equal to a value of "Completed". Then, an action specified using control **324** is to be taken. FIG. **2**B shows an example in which control **324** is a drop down menu, but it could be others controls as well. In addition, the user interface display **302** in FIG. **2**B includes controls **334** and **336** which can be actuated to add additional conditions or additional actions, respectively. Again, the examples shown in FIGS. **2**A and **2**B are examples only, and a wide variety of other authoring user interface displays, with authoring user input mechanisms, can be used.

FIG. **3** is a block diagram of architecture **100**, which is similar to that shown in FIG. **1**, and similar items are similarly numbered. However, FIG. **3** shows sub-application runtime system **122**, in more detail, and a user **109** can use user input mechanism **111** on interfaces **113** to run a sub-

application (or task-based flow). FIG. **3** shows that, in one example, sub-application runtime system **122** includes launch point detector logic **350**, navigation system **352** (which itself, can include navigation detector logic **354** and navigation stack manager logic **356**), logic handling system **358**, cross-page eventing logic **360**, cross-page error handling logic **362**, or task-based flow container generation logic **364**, a TB (or task-based) flow container **366**, and it can include other items **368**. Generation logic **364** can include task-based (or TB) flow identifier logic **370**, page identifier logic **372**, data retrieval logic **374**, and other items **376**. The container **366** illustrated in FIG. **3** includes a set of pages labeled pages **1**, **2**, **3** and N. In addition, an active page indicator **380** points to an active page within container **366**. A navigation stack **382** shows the pages that have been navigated to in the task-based flow represented by container **366**. Thus, it can be seen that the flow has navigated to pages **1**, **3**, **2** and then back to **3**, in that order.

Each page includes a header **384**, a set of sections labeled section **1**-section N, and a footer **386**. Some examples of pages have been discussed in more detail above with respect to FIGS. **1**A and **1**B. Before describing the operation of sub-application runtime system **122** in more detail, an overview of some of the items in system **122**, and their operation, will first be provided.

Launch point actuation detector **350** detects that a launch point in the parent application has been actuated. Again, it can be automatically or manually actuated, and indicates that the corresponding task-based flow is to be run. Container generation logic **364** then uses flow identifier logic **370** to identify which particular task-based flow is to be launched. Page identifier logic **372** identifies the particular page that is to be displayed first for that task-based flow, and data retrieval logic **374** retrieves the data and populates the page to be displayed. Using this information, logic **364** generates task-based flow container **366**. It includes containers for various pages **1**-N which are in the task-based flow, and it sets the active page indicator **380** to the active page. It then controls user interface logic **116** to display the active page (such as in a pop-up or otherwise) within the parent application.

Navigation system **352** controls the navigation stack **382** so that the proper page is displayed, based upon the various navigation inputs that can be received. Navigation detector logic **354** detects a navigation input (such as the user pressing the "next" or "back" buttons on the displayed page, or other navigation inputs) and navigation stack manager logic **356** identifies which page is to be displayed next and loads information for that page.

Logic handling system **358** handles (such as executes) any logic on (or corresponding to) the displayed page. It can also handle the branching logic which determines which page is to be displayed next, in the task-based flow. This information can be provided to navigation stack manager logic **356** which loads information for the next page to be displayed, and navigates the user to that page.

Cross-page eventing logic **360** handles any cross-page eventing that has been configured for the task-based flow. If an event occurs on one page of the task-based flow, another page or a control on another page may have registered to receive a notification of that event. Cross-page eventing logic handles these types of registrations and notifications.

Cross-page error handling logic **362** handles any cross-page error messages or error processing that is to be performed. By way of example, if a particular value is entered on a page being displayed, this may cause an error on a page that may be displayed in the future, on a page that was displayed in the past, or a page that may not be displayed in the current instance of the task-based flow.

FIG. **4** is a flow diagram illustrating one example of the operation of sub-application runtime system **122**, in more detail. It is first assumed that the parent application, from which the task-based flow will be launched, is running in computing system **102**. This is indicated by block **390** in FIG. **4**.

At some point, launch point actuation detector **350** will detect a task-based flow launch input that indicates that a task-based flow should be launched within the parent application. This is indicated by block **392**. It will be noted that, in one example, navigation system **126** in the parent application performs stack management for the parent application. This is indicated by block **394**. Navigation system **352** can also perform navigation management for the task-based flow, within the parent application. Therefore, it can maintain its own navigation stack and perform its own stack management, even while navigation system **126** in the parent application is performing its stack management. In doing so, it may open the task-based flow in a pop-up, or another view, within the parent application.

It will also be noted that, in one example, the launch point is user actuated. This is indicated by block **396**. It can also be automatically actuated as indicated by block **398**. The sub-application (or task-based flow) launch input can be received in other ways as well, and this is indicated by block **400**.

Flow identifier logic **380** then identifies the particular task-based flow or sub-application to be launched. This is indicated by block **402**. The identity of that task-based flow can be included in the launch input, as indicated by block **404**. It can also be based on a context of the parent application. For instance, the context of the parent application may, itself, identify or indicate which particular task-based flow is to be launched. This is indicated by block **406**. The identity of which particular task-based flow to launch can be identified in other ways as well, and this is indicated by block **408**.

Page identifier logic **372** then accesses the sub-application definition metadata for the identified task-based flow to determine which particular page of that flow is to be displayed first. Identifying the page is indicated by block **410** in FIG. **4**. Container generation logic **364** then generates a task-based flow container **366** for the identified sub-application (or task-based flow). This is indicated by block **412**. Data retrieval logic **374** illustratively retrieves data and logic for the first page to be displayed. This is indicated by block **414**. It will also be noted that data for more than just the first page may be retrieved to reduce navigation latency or for other reasons. It populates and displays that page to the user, as indicated by block **416**. It also illustratively sets the active page indicator **380** to indicate which particular page is active (or is currently being displayed). This is indicated by block **418**.

At that point, logic handling system **358** simply waits to determine whether any user inputs are received. At some point, a user input will be detected on the displayed page. This is indicated by block **420**. Logic handling system **358** (or other items in sub-application runtime system **122**) then processes that user input. This is indicated by block **422**. For instance, if the task-based flow is one which calls a child task-based flow, then it may queue a request for that child flow to be picked up by another user or another system. This is indicated by block **424**. It may execute any logic that is configured for the displayed page, or otherwise, in the task-based flow. This is indicated by block **426**. Cross-page

eventing logic **360** and cross-page error handling logic **362** can perform any cross-page eventing or error handling. This is indicated by blocks **428** and **430**, respectively. The user inputs can be handled or processed in a wide variety of other ways as well, and this is indicated by block **432**.

It may be that navigation detector logic **354** detects a navigation input. For instance, it may be that the user has actuated the "next" or "back" buttons on the displayed page. It may be that the user has actuated another control that will navigate the user to a page which is out of a linear sequence in the task-based flow, or which launches another task-based flow. It may be that a navigation input is automatically generated, based upon other user or system actions. All of these are contemplated herein. Detecting a navigation input is indicated by block **434** in FIG. **4**.

Logic handling system **358** then identifies any branching logic that is to be executed, based upon the navigation input, and based upon the context of the task-based flow. For instance, it may be that the user has changed control states on the displayed page to a first value and actuated the "next" button. In that case, there may be conditional logic that navigates the user to another page in the task-based flow. However, if the user had changed the control states to a second value, then the branching logic may point to a different next page. Identifying any branching logic and executing the branching logic to identify the next page is indicated by blocks **436** and **438** in FIG. **4**.

When the user navigates away from a page in the task-based flow, it may be that some data that was entered on that page needs to be saved. This is indicated by block **440**. If so, then data retrieval/save logic **374** pushes that data back to the appropriate entities in the application. For instance, as discussed above, a page in the task-based flow may include fields from a plurality of different entities (or application objects). If the user changes data in any of those fields, then logic **374** identifies the particular entity from which the field was retrieved (or the underlying table entries in data store **112**) and stores the modified data in the identified locations. This is indicated by block **442** in FIG. **4**. Then, data retrieval/save logic **374** retrieves data for the next page that was identified in response to receiving the navigation input, and that page is populated and displayed as indicated by blocks **414** and **416**, and processing continues at that point in the task-based flow.

At some point, the task represented by the task-based flow, or the task-based flow itself may be closed by the user or by the system. This is indicated by block **444** in FIG. **4**.

FIGS. **5** and **6** show a set of flow diagrams that include examples of user interface displays that can be generated during a task-based flow, along with arrows indicating how the task-based flow advances given its branching logic. FIGS. **5** and **6** will now be described in conjunction with another.

FIG. **5** shows that, in one example, a task-based flow, for performing a task of submitting an approval request, is first launched. A user interface display, such as display **450** can be displayed. Display **450** shows a set of fields that can be edited by the user, and specify information relating to a quote that is to be sent for ordering a set of products. User interface display **450** also includes a set of actuators **452** and **454** that allow the user to submit the quote for approval, or to cancel the quote.

Block **456** identifies the particular branching logic that is used to determine what will happen when the user actuates the submit actuator **454**. The branching logic is specified in the "if-then" format and identifies three different approval levels, based upon values entered in the fields in user interface display **450**. When the user actuates the submit actuator **454**, logic handling system **358** evaluates that "if-then" statement and identifies an approval level that is needed. It then sets a status for the approval request task-based flow to pending. System **358** also requests another task-based flow to be run (the "approval review" flow), as a child of the approval request flow. This action is indicated by block **458** in FIG. **5**. The request to have the "approval review" flow run is then queued for a particular manager or other person who needs to review the quote.

When that manager launches the "approval review" task-based flow, a user interface display, such as display **460** shown in FIG. **6**, is displayed for that manager. In addition, as is described below, it may be that more than one person needs to approve the request. Therefore, block **461** indicates that logic handling system **358** performs a step of setting a counter (ApprovalCount) to zero.

Display **460** shows that the terms of the quote are displayed, along with three actuators. A "reject" actuator **462** can be actuated to reject the approval. A "more info" actuator **464** can be actuated to request more information about the approval request, and the "approve" actuator **466** can be actuated to approve the request. Each of these navigates differently within the "approval review" task-based flow.

If the manager actuates the "reject" actuator **462**, then the navigation system **352** displays for the manager a next page, such as page **468**, in the "approval review" task-based flow. Page **468** provides a control that allows the manager to enter reasons that the approval was rejected, along with a set of actuators **470** and **472** that the manager can actuate to either go back to page **460**, or to actually send a rejection of the request, respectively. If the manager actuates the reject actuator **472**, then the status of the approval request set in block **458** of FIG. **5** is now set to "rejected" and the requestor that requested the approval is notified (such as by e-mail or by other notification). This is indicated by block **474**. Processing then returns to the task-based flow illustrated by blocks **476** and **478** in FIG. **5**, at which point both the child task-based flow represented in FIG. **6** and the parent task-based flow represented in FIG. **5** are terminated.

Returning again to the user interface **460** in FIG. **6**, if the manager actuates the "more info" actuator **464**, then logic handling system **458** sends an electronic mail message, or other message, to the requestor, requesting more information. This is indicated by block **480**. The status of the request is then set to "more information requested". This is indicated by block **482**.

If, at the user interface display **460**, the manager actuates the "approve" actuator, then navigation system **352** identifies the "approve" page **484** as the next page to be displayed. Logic handling system **358** adds one to the ApprovalCount counter because the present manager actuated the "approve" actuator. Page **484** also has logic that is evaluated to determine whether additional approvals are needed for the approval request. In FIG. **6**, the logic indicates that additional approvals will be needed, based upon values entered in display **460** (e.g., based upon the discount being 8%).

In one example, the manager can also be provided on display **484** with actuators **486** and **488**. If the manager actuates actuator **488**, then logic handling system **358** executes logic that calculates the number of approvals that have been received to determine whether the request is now approved, or whether it needs additional approvals. This is indicated by block **490**. Then, as indicated by block **492**, if a sufficient number of approvals have been received, the requestor is notified (such as through an electronic mail

message or other notification) that the request has been approved. This is indicated by block **494**. Again, the task-based flow illustrated in FIG. **6** returns to that illustrated in FIG. **5** as indicated by blocks **496** and **478** in FIG. **6** and FIG. **5**, respectively.

However, if, at block **492**, it is determined that additional approvals are still needed, then the approval request is assigned to yet another approver (e.g., another manager) as indicated by block **498**. This can be done by queuing the approval request as a task-based flow for the additional approver, and waiting for the results of that task-based flow to be returned.

It can thus be seen that the present system displays pages in a task-based flow. The pages can include fields or controls from a plurality of different entities, so that those fields or controls can be displayed, and interacted with, so a user can perform a task without retrieving and surfacing the forms that represent all of those underlying application objects (or entities). This significantly saves round trips from the computing system to the data store, and thus reduces time and computing overhead needed to perform a task. The sub-application runtime system maintains its own navigation control and navigation stack, on top of that maintained for the parent application, from which the task-based flow was launched. The sub-application runtime system also performs cross-page event handling and error handling, within the task-based flow. Again, because this is done on the pages of the task-based flow, it does not involve retrieving and materializing forms that represent the underlying application objects (or entities). This also significantly reduces the latency, computing overhead, and network bandwidth needed for round trips to the data store.

The present discussion has mentioned processors and servers. In one embodiment, the processors and servers include computer processors with associated memory and timing circuitry, not separately shown. They are functional parts of the systems or devices to which they belong and are activated by, and facilitate the functionality of the other components or items in those systems.

Also, a number of user interface displays have been discussed. They can take a wide variety of different forms and can have a wide variety of different user actuatable input mechanisms disposed thereon. For instance, the user actuatable input mechanisms can be text boxes, check boxes, icons, links, drop-down menus, search boxes, etc. They can also be actuated in a wide variety of different ways. For instance, they can be actuated using a point and click device (such as a track ball or mouse). They can be actuated using hardware buttons, switches, a joystick or keyboard, thumb switches or thumb pads, etc. They can also be actuated using a virtual keyboard or other virtual actuators. In addition, where the screen on which they are displayed is a touch sensitive screen, they can be actuated using touch gestures. Also, where the device that displays them has speech recognition components, they can be actuated using speech commands.

A number of data stores have also been discussed. It will be noted they can each be broken into multiple data stores. All can be local to the systems accessing them, all can be remote, or some can be local while others are remote. All of these configurations are contemplated herein.

Also, the figures show a number of blocks with functionality ascribed to each block. It will be noted that fewer blocks can be used so the functionality is performed by fewer components. Also, more blocks can be used with the functionality distributed among more components.

It will be noted that the above discussion has described a variety of different systems, components and/or logic. It will be appreciated that such systems, components and/or logic can be comprised of hardware items (such as processors and associated memory, or other processing components, some of which are described below) that perform the functions associated with those systems, components and/or logic. In addition, the systems, components and/or logic can be comprised of software that is loaded into a memory and is subsequently executed by a processor or server, or other computing component, as described below. The systems, components and/or logic can also be comprised of different combinations of hardware, software, firmware, etc., some examples of which are described below. These are only some examples of different structures that can be used to form the systems, components and/or logic described above. Other structures can be used as well.

FIG. **7** is a block diagram of architecture **100**, shown in FIGS. **1** and **3**, except that its elements are disposed in a cloud computing architecture **500**. Cloud computing provides computation, software, data access, and storage services that do not require end-user knowledge of the physical location or configuration of the system that delivers the services. In various embodiments, cloud computing delivers the services over a wide area network, such as the internet, using appropriate protocols. For instance, cloud computing providers deliver applications over a wide area network and they can be accessed through a web browser or any other computing component. Software or components of architecture **100** as well as the corresponding data, can be stored on servers at a remote location. The computing resources in a cloud computing environment can be consolidated at a remote data center location or they can be dispersed. Cloud computing infrastructures can deliver services through shared data centers, even though they appear as a single point of access for the user. Thus, the components and functions described herein can be provided from a service provider at a remote location using a cloud computing architecture. Alternatively, they can be provided from a conventional server, or they can be installed on client devices directly, or in other ways.

The description is intended to include both public cloud computing and private cloud computing. Cloud computing (both public and private) provides substantially seamless pooling of resources, as well as a reduced need to manage and configure underlying hardware infrastructure.

A public cloud is managed by a vendor and typically supports multiple consumers using the same infrastructure. Also, a public cloud, as opposed to a private cloud, can free up the end users from managing the hardware. A private cloud may be managed by the organization itself and the infrastructure is typically not shared with other organizations. The organization still maintains the hardware to some extent, such as installations and repairs, etc.

In the example shown in FIG. **7**, some items are similar to those shown in FIGS. **1** and **3** and they are similarly numbered. FIG. **7** specifically shows that computing system **102** can be located in cloud **502** (which can be public, private, or a combination where portions are public while others are private). Therefore, author **108** or user **109** uses a user device **504** or **505** to access those systems through cloud **502**.

FIG. **7** also depicts another example of a cloud architecture. FIG. **7** shows that it is also contemplated that some elements of computing system **102** are disposed in cloud **502** while others are not. By way of example, data store **112** can be disposed outside of cloud **502**, and accessed through

cloud **502**. In another example, sub-application authoring system **120**, or other systems or logic, can also be outside of cloud **502**. Regardless of where they are located, they can be accessed directly by device **504**, through a network (either a wide area network or a local area network), they can be hosted at a remote site by a service, or they can be provided as a service through a cloud or accessed by a connection service that resides in the cloud. All of these architectures are contemplated herein.

It will also be noted that architecture **100**, or portions of it, can be disposed on a wide variety of different devices. Some of those devices include servers, desktop computers, laptop computers, tablet computers, or other mobile devices, such as palm top computers, cell phones, smart phones, multimedia players, personal digital assistants, etc.

FIG. **8** is a simplified block diagram of one illustrative example of a handheld or mobile computing device that can be used as a user's or client's hand held device **16**, in which the present system (or parts of it) can be deployed. FIGS. **9-10** are examples of handheld or mobile devices.

FIG. **8** provides a general block diagram of the components of a client device **16** that can run components of architecture **100** or that interacts with architecture **100**, or both. In the device **16**, a communications link **13** is provided that allows the handheld device to communicate with other computing devices and under some embodiments provides a channel for receiving information automatically, such as by scanning. Examples of communications link **13** include an infrared port, a serial/USB port, a cable network port such as an Ethernet port, and a wireless network port allowing communication though one or more communication protocols including General Packet Radio Service (GPRS), LTE, HSPA, HSPA+ and other 3G and 4G radio protocols, 1Xrtt, and Short Message Service, which are wireless services used to provide cellular access to a network, as well as Wi-Fi protocols, and Bluetooth protocol, which provide local wireless connections to networks.

In other examples, applications or systems are received on a removable Secure Digital (SD) card that is connected to a SD card interface **15**. SD card interface **15** and communication links **13** communicate with a processor **17** (which can also embody processors or servers **114** from FIGS. **1** and **3**) along a bus **19** that is also connected to memory **21** and input/output (I/O) components **23**, as well as clock **25** and location system **27**.

I/O components **23**, in one embodiment, are provided to facilitate input and output operations. I/O components **23** for various embodiments of the device **16** can include input components such as buttons, touch sensors, multi-touch sensors, optical or video sensors, voice sensors, touch screens, proximity sensors, microphones, tilt sensors, and gravity switches and output components such as a display device, a speaker, and or a printer port. Other I/O components **23** can be used as well.

Clock **25** illustratively comprises a real time clock component that outputs a time and date. It can also, illustratively, provide timing functions for processor **17**.

Location system **27** illustratively includes a component that outputs a current geographical location of device **16**. This can include, for instance, a global positioning system (GPS) receiver, a LORAN system, a dead reckoning system, a cellular triangulation system, or other positioning system. It can also include, for example, mapping software or navigation software that generates desired maps, navigation routes and other geographic functions.

Memory **21** stores operating system **29**, network settings **31**, applications **33**, application configuration settings **35**, data store **37**, communication drivers **39**, and communication configuration settings **41**. Memory **21** can include all types of tangible volatile and non-volatile computer-readable memory devices. It can also include computer storage media (described below). Memory **21** stores computer readable instructions that, when executed by processor **17**, cause the processor to perform computer-implemented steps or functions according to the instructions. Similarly, device **16** can have a client system **24** which can run various business applications or embody parts or all of architecture **100**. Processor **17** can be activated by other components to facilitate their functionality as well.

Examples of the network settings **31** include things such as proxy information, Internet connection information, and mappings. Application configuration settings **35** include settings that tailor the application for a specific enterprise or user. Communication configuration settings **41** provide parameters for communicating with other computers and include items such as GPRS parameters, SMS parameters, connection user names and passwords.

Applications **33** can be applications that have previously been stored on the device **16** or applications that are installed during use, although these can be part of operating system **29**, or hosted external to device **16**, as well.

FIG. **9** shows one example in which device **16** is a tablet computer **600**. In FIG. **9**, computer **600** is shown with user interface display screen **602**. Screen **602** can be a touch screen (so touch gestures from a user's finger can be used to interact with the application) or a pen-enabled interface that receives inputs from a pen or stylus. It can also use an on-screen virtual keyboard. Of course, it might also be attached to a keyboard or other user input device through a suitable attachment mechanism, such as a wireless link or USB port, for instance. Computer **600** can also illustratively receive voice inputs as well.

Additional examples of devices **16** can be used as well. Device **16** can be, a feature phone, smart phone or mobile phone. The phone can include a set of keypads for dialing phone numbers, a display capable of displaying images including application images, icons, web pages, photographs, and video, and control buttons for selecting items shown on the display. The phone can include an antenna for receiving cellular phone signals such as General Packet Radio Service (GPRS) and 1Xrtt, and Short Message Service (SMS) signals. In some examples the phone also includes a Secure Digital (SD) card slot that accepts a SD card.

FIG. **10** shows that the device can be a smart phone **71**. Smart phone **71** has a touch sensitive display **73** that displays icons or tiles or other user input mechanisms **75**. Mechanisms **75** can be used by a user to run applications, make calls, perform data transfer operations, etc. In general, smart phone **71** is built on a mobile operating system and offers more advanced computing capability and connectivity than a feature phone.

Note that other forms of the devices **16** are possible.

FIG. **11** is one example of a computing environment in which architecture **100**, or parts of it, (for example) can be deployed. With reference to FIG. **11**, an example system for implementing some embodiments includes a general-purpose computing device in the form of a computer **810**. Components of computer **810** may include, but are not limited to, a processing unit **820** (which can comprise processors or servers **114**) or those on other user devices, a system memory **830**, and a system bus **821** that couples various system components including the system memory to the processing unit **820**. The system bus **821** may be any of

several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI) bus also known as Mezzanine bus. Memory and programs described with respect to FIG. **1** can be deployed in corresponding portions of FIG. **11**.

Computer **810** typically includes a variety of computer readable media. Computer readable media can be any available media that can be accessed by computer **810** and includes both volatile and nonvolatile media, removable and non-removable media. By way of example, and not limitation, computer readable media may comprise computer storage media and communication media. Computer storage media is different from, and does not include, a modulated data signal or carrier wave. It includes hardware storage media including both volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by computer **810**. Communication media typically embodies computer readable instructions, data structures, program modules or other data in a transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer readable media.

The system memory **830** includes computer storage media in the form of volatile and/or nonvolatile memory such as read only memory (ROM) **831** and random access memory (RAM) **832**. A basic input/output system **833** (BIOS), containing the basic routines that help to transfer information between elements within computer **810**, such as during start-up, is typically stored in ROM **831**. RAM **832** typically contains data and/or program modules that are immediately accessible to and/or presently being operated on by processing unit **820**. By way of example, and not limitation, FIG. **11** illustrates operating system **834**, application programs **835**, other program modules **836**, and program data **837**.

The computer **810** may also include other removable/non-removable volatile/nonvolatile computer storage media. By way of example only, FIG. **10** illustrates a hard disk drive **841** that reads from or writes to non-removable, nonvolatile magnetic media, and an optical disk drive **855** that reads from or writes to a removable, nonvolatile optical disk **856** such as a CD ROM or other optical media. Other removable/non-removable, volatile/nonvolatile computer storage media that can be used in the exemplary operating environment include, but are not limited to, magnetic tape cassettes, flash memory cards, digital versatile disks, digital video tape, solid state RAM, solid state ROM, and the like. The hard disk drive **841** is typically connected to the system bus **821** through a non-removable memory interface such as interface **840**, and optical disk drive **855** are typically connected to the system bus **821** by a removable memory interface, such as interface **850**.

Alternatively, or in addition, the functionality described herein can be performed, at least in part, by one or more hardware logic components. For example, and without limitation, illustrative types of hardware logic components that can be used include Field-programmable Gate Arrays (FPGAs), Program-specific Integrated Circuits (ASICs), Program-specific Standard Products (ASSPs), System-on-a-chip systems (SOCs), Complex Programmable Logic Devices (CPLDs), etc.

The drives and their associated computer storage media discussed above and illustrated in FIG. **11**, provide storage of computer readable instructions, data structures, program modules and other data for the computer **810**. In FIG. **11**, for example, hard disk drive **841** is illustrated as storing operating system **844**, application programs **845**, other program modules **846**, and program data **847**. Note that these components can either be the same as or different from operating system **834**, application programs **835**, other program modules **836**, and program data **837**. Operating system **844**, application programs **845**, other program modules **846**, and program data **847** are given different numbers here to illustrate that, at a minimum, they are different copies.

A user may enter commands and information into the computer **810** through input devices such as a keyboard **862**, a microphone **863**, and a pointing device **861**, such as a mouse, trackball or touch pad. Other input devices (not shown) may include a joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit **820** through a user input interface **860** that is coupled to the system bus, but may be connected by other interface and bus structures, such as a parallel port, game port or a universal serial bus (USB). A visual display **891** or other type of display device is also connected to the system bus **821** via an interface, such as a video interface **890**. In addition to the monitor, computers may also include other peripheral output devices such as speakers **897** and printer **896**, which may be connected through an output peripheral interface **895**.

The computer **810** is operated in a networked environment using logical connections to one or more remote computers, such as a remote computer **880**. The remote computer **880** may be a personal computer, a hand-held device, a server, a router, a network PC, a peer device or other common network node, and typically includes many or all of the elements described above relative to the computer **810**. The logical connections depicted in FIG. **11** include a local area network (LAN) **871** and a wide area network (WAN) **873**, but may also include other networks. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

When used in a LAN networking environment, the computer **810** is connected to the LAN **871** through a network interface or adapter **870**. When used in a WAN networking environment, the computer **810** typically includes a modem **872** or other means for establishing communications over the WAN **873**, such as the Internet. The modem **872**, which may be internal or external, may be connected to the system bus **821** via the user input interface **860**, or other appropriate mechanism. In a networked environment, program modules depicted relative to the computer **810**, or portions thereof, may be stored in the remote memory storage device. By way of example, and not limitation, FIG. **11** illustrates remote

application programs **885** as residing on remote computer **880**. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

It should also be noted that the different embodiments described herein can be combined in different ways. That is, parts of one or more embodiments can be combined with parts of one or more other embodiments. All of this is contemplated herein.

Example 1 is a computing system, comprising:

an application component that runs a parent application for performing a process, the parent application component including a parent navigation system that navigates a user through a plurality of parent application pages, each parent application page having display elements representing an application object; and

a sub-application runtime system that launches and runs a sub-application for performing a task, from within the parent application, the sub-application runtime system including a sub-application navigation system that navigates the user through a plurality of sub-application pages, each sub-application page having a set of display elements comprising a subset of display elements on a parent application page.

Example 2 is the computing system of any or all previous examples wherein the sub-application runtime system comprises:

cross-page eventing logic that detects an event on a displayed page, of the sub-application pages, and notifies another of the sub-application pages of the detected event.

Example 3 is the computing system of any or all previous examples wherein the sub-application runtime system comprises:

cross-page error handling logic that detects an error on a displayed page, of the sub-application pages, and generates an error on another of the sub-application pages based on the detected error.

Example 4 is the computing system of any or all previous examples wherein the sub-application runtime system comprises:

sub-application container generation logic that generates a task-based flow container with at least a first of the sub-application pages and a navigation stack.

Example 5 is the computing system of any or all previous examples wherein the sub-application runtime system comprises:

launch point detector logic that detects a launch point indicator, corresponding to the sub-application, from within the parent application.

Example 6 is the computing system of any or all previous examples wherein the sub-application container generation logic comprises:

flow identifier logic that identifies the sub-application to be launched based on the launch point detector logic detecting the launch point indicator.

Example 7 is the computing system of any or all previous examples wherein the sub-application container generation logic comprises:

page identifier logic that accesses sub-application metadata defining the identified sub-application to identify the first sub-application page for the identified sub-application.

Example 8 is the computing system of any or all previous examples wherein the sub-application container generation logic comprises:

data logic that accesses the sub-application metadata and retrieves data and controls for the first sub-application page and populates the first sub-application page with the retrieved data and controls.

Example 9 is the computing system of any or all previous examples wherein the sub-application navigation system comprises:

navigation detector logic that detects a navigation input from a displayed sub-application page.

Example 10 is the computing system of any or all previous examples wherein the sub-application runtime system comprises:

a logic handling system that executes branching logic corresponding to the displayed sub-application page, based on a state of the displayed sub-application page and the navigation input, to identify a next sub-application page.

Example 11 is the computing system of any or all previous examples wherein the data logic comprises data save logic that identifies any data to be saved from the sub-application, identifies the application objects where the identified data is to be saved, and pushes the data to be saved to the identified application objects.

Example 12 is the computing system of any or all previous examples wherein the sub-application navigation system comprises:

navigation stack manager logic that navigates to the next sub-application page identified by the logic handling system.

Example 13 is the computing system of any or all previous examples wherein the logic handling system identifies a child sub-application to launch based on the state of the displayed sub-application page and the navigation input, the sub-application runtime system pausing the sub-application, launching the child sub-application, and later resuming the sub-application.

Example 14 is a computer implemented method, comprising:

performing a process in a running parent application, by navigating a user through a plurality of parent application pages, each parent application page having display elements representing an application object; and

launching and running a sub-application for performing a task, from within the parent application, by navigating the user through a plurality of sub-application pages, each sub-application page having a set of display elements comprising a subset of display elements on at least one parent application page.

Example 15 is the computer implemented method of any or all previous examples wherein running the sub-application comprises:

detecting an event on a displayed page, of the sub-application pages; and

notifying another of the sub-application pages of the detected event.

Example 16 is the computer implemented method of any or all previous examples wherein running the sub-application comprises:

detecting an error on a page, of the sub-application pages; and

generating an error on a page of the sub-application pages based on the detected error.

Example 17 is the computer implemented method of any or all previous examples wherein running the sub-application comprises:

generating a task-based flow container with at least a first of the sub-application pages and a navigation stack;

receiving a user input through a user input mechanism on the first sub-application page;

executing sub-application branching logic based on the user input and based on data in the sub-application; and

navigating the user through the navigation stack based on execution of the sub-application branching logic.

Example 18 is the computer implemented method of any or all previous examples wherein launching and running the sub-application comprises:

detecting actuation of a launch point control, corresponding to the sub-application, from within the parent application;

identifying the sub-application to be launched based on detecting actuation of the launch point control;

accessing sub-application metadata defining the identified sub-application to identify the first sub-application page for the identified sub-application;

retrieving data and controls for at least the first sub-application page; and

populating the first sub-application page with the retrieved data and controls.

Example 19 is the computer implemented method of any or all previous examples wherein running the sub-application comprises:

before navigating the user, identifying any data to be saved from the displayed sub-application page;

identifying the application objects where the identified data is to be saved; and

pushing the data to be saved to the identified application objects.

Example 20 is a computing system comprising:

an application component that runs a parent application for performing a process, the parent application component including a parent navigation system that navigates a user through a plurality of parent application pages, each parent application page having display elements representing an application object;

a sub-application runtime system that launches and runs a sub-application for performing a task, from within the parent application, the sub-application runtime system including:

a sub-application navigation system that navigates the user through a plurality of sub-application pages, each sub-application page having a set of display elements comprising a subset of display elements on a parent application page;

cross-page eventing logic that detects an event on a displayed page, of the sub-application pages, and notifies another of the sub-application pages of the detected event;

cross-page error handling logic configured to detect an error on the displayed page, of the sub-application pages, and generate an error on another of the sub-application pages based on the detected error; and

a logic handling system that identifies a child sub-application to launch based on the state of the displayed sub-application page and a detected navigation input, the sub-application runtime system launching the child sub-application.

Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

What is claimed is:

1. A computing system, comprising:

a processor; and

memory storing instructions executable by the processor, wherein the instructions, when executed, configure the computing system to provide:

an application component configured to:

run a parent application; and

navigate a user through a plurality of parent application pages, each parent application page having user interface (UI) controls;

launch point detector logic configured to detect a launch point indicator that is indicative of a launch point corresponding to a task associated with an application object in the parent application;

flow identifier logic configured to identify a sub-application to be launched based on the launch point indicator; and

a sub-application runtime system configured to:

launch the identified sub-application having a sub-application page configured to perform the task, the sub-application page having a set of UI controls comprising a subset of the UI controls on a parent application page;

receive an indication of user input through the sub-application page; and

provide data associated with the user input to the application object in the parent application.

2. The computing system of claim **1** wherein the sub-application page comprises a first sub-application page of a plurality of sub-application pages, and the sub-application runtime system is configured to:

detect an event on the first sub-application page; and

provide a notification, indicative of the detected event, to a second one of the sub-application pages.

3. The computing system of claim **1** wherein the sub-application page comprises a first sub-application page of a plurality of sub-application pages, and the sub-application runtime system is configured to:

detect an error on the first sub-application page; and

generate an error on a second one of the sub-application pages based on the detected error.

4. The computing system of claim **1** wherein the sub-application runtime system is configured to:

generate a task-based flow container with at least the sub-application page and a navigation stack.

5. The computing system of claim **4** wherein the navigation stack is separate from the parent application.

6. The computing system of claim **5** wherein the sub-application container generation logic is configured to:

run the sub application sub-application by executing navigation logic.

7. The computing system of claim **6** wherein the sub-application runtime system is configured to:

access sub-application metadata associated with the sub-application; and

based on the sub-application metadata, identify the sub-application page.

8. The computing system of claim **7** wherein the sub-application runtime system is configured to:

based on the sub-application metadata,

retrieve the data and the UI controls for the sub-application page, and

populate the sub-application page with the retrieved data and UI controls.

9. The computing system of claim **8** wherein the sub-application runtime system is configured to:

detect a navigation input from the sub-application page.

10. The computing system of claim **9** wherein the sub-application page comprises a first sub-application page of a plurality of sub-application pages, and the sub-application runtime system is configured to:

based on a state of the first sub-application page and the navigation input, execute branching logic correspond-

ing to the first sub-application page to identify a second one of the sub-application pages.

11. The computing system of claim **10** wherein the data logic comprises data save logic configured to:

identify data to be saved from the sub-application;

identify the application object where the identified data is to be saved; and

push the data to be saved to the identified application object.

12. The computing system of claim **11** wherein the sub-application runtime system is configured to:

navigate to the second sub-application page.

13. The computing system of claim **12** wherein the sub-application runtime system is configured to:

based on the state of the displayed sub-application page and the navigation input, identify a child sub-application to launch;

pause the sub-application;

launch the child sub-application; and

later resume the sub-application.

14. A computer implemented method, comprising:

running parent application that navigates a user through a plurality of parent application pages, each parent application page having user interface (UI) controls;

detecting a launch point indicator that is indicative of a launch point corresponding to a task associated with an application object in the parent application;

identifying a sub-application to be launched based on the launch point indicator; and

running the sub-application having a sub-application page configured to perform the task, the sub-application page having a set of UI controls comprising a subset of the UI controls on at least one of the parent application pages;

receiving an indication of user input through the sub-application page; and

providing data associated with the user input to the application object in the parent application.

15. The computer implemented method of claim **14** wherein the sub-application page comprises a first sub-application page of a plurality of sub-application pages, and running the sub-application comprises:

detecting an event on the first sub-application page; and

notifying a second one of the sub-application pages of the detected event.

16. The computer implemented method of claim **15** wherein running the sub-application comprises:

detecting an error on the first sub-application page; and

generating an error on the second sub-application page based on the detected error.

17. The computer implemented method of claim **14** wherein running the sub-application comprises:

generating a task-based flow container with at least the sub-application page and a navigation stack;

receiving an indication of a user input through a user input mechanism on the sub-application page;

executing sub-application branching logic based on the user input and based on data in the sub-application; and

navigating the user through the navigation stack based on execution of the sub-application branching logic.

18. The computer implemented method of claim **17** wherein launching and running the sub-application comprises:

detecting actuation of a launch point control, corresponding to the sub-application, from within the parent application;

identifying the sub-application to be launched based on detecting actuation of the launch point control;

accessing sub-application metadata defining the identified sub-application to identify the sub-application page;

retrieving data and controls for the sub-application page; and

populating the sub-application page with the retrieved data and controls.

19. The computer implemented method of claim **18** wherein running the sub-application comprises:

before navigating the user, identifying any data to be saved from the sub-application page;

identifying the application object where the identified data is to be saved; and

pushing the data to be saved to the identified application object.

20. A computing system comprising:

a processor; and

memory storing instructions executable by the processor, wherein the instructions, when executed, configure the computing system to:

run a parent application for performing a process, the parent application component including a parent navigation system that navigates a user through a plurality of parent application pages, each parent application page having UI controls representing an application object;

run a sub-application for performing a task, from within the parent application;

navigate the user through a plurality of sub-application pages, each sub-application page having a set of UI controls comprising a subset of UI controls on a parent application page;

detect an event on a displayed page, of the sub-application pages, and notifies another of the sub-application pages of the detected event;

detect an error on the displayed page, of the sub-application pages;

generate an error on another of the sub-application pages based on the detected error; and

identify a child sub-application to launch based on the state of the displayed sub-application page and a detected navigation input; and

launch the child sub-application.

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